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On Indisposition after Running*

(Athlete's Sickness and Vasomotor Collapse)

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A VERY interesting clinical syndrome has been reported recently by E. Asmussen[1]† ('37) that is frequently observed in athletes, consisting of sudden attacks of weakness, sweating, and headache followed by marked sickness and ultimately vomiting. This syndrome was originally described by the writer[11] ('30), and since then he has repeatedly published results of further studies of this condition.[14, 16, 19] As the writer believes that Asmussen's paper contains a number of erroneous statements, it seems advisable to re-open the discussion of this important condition.

Asmussen has committed the same mistake that has been made by various authors before him (*e.g.*, Mateeff,[31] Weltzien,[42] Herxheimer[35]) namely to confuse two entirely different clinical conditions. The syndrome to which he apparently refers is called athlete's sickness (*sportkrankheit*). This condition is not a vasomotor collapse as Asmussen obviously believes. Vasomotor collapse, much rarer among sportsmen than athlete's sickness, differs entirely from the latter condition and is, the author contends, invariably of a serious nature. Vasomotor collapse is accompanied by actual unconsciousness which never occurs in the course of athlete's sickness. Athlete's sickness lasts for a few minutes, while vasomotor collapse is distinguished by a long recovery time.

In contrast to those forms of collapse which can be produced experimentally in healthy animals (L. Hill,[6, 7] Eppinger[2]), and in sportsmen (Mateeff and Petroff[30]), such vasomotor breakdowns as occur spontaneously during exercise are almost always indications of a temporary impairment of health (Jokl[14]), of serious illness (Marvin and Sullivan[29]), of a defective constitution (Lennox and collaborators[25]), or grossly abnormal environmental conditions, such as quoted by the writer's collaborator Weiner,[43] Jokl,[19] McCurdy and McKenzie,[32] and MacKenzie.[28] Athlete's sickness, on the other hand, is a harmless functional disorder to which no unfavorable prognostic significance can be attached.

The name "athlete's sickness" was chosen because of its analogy

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† Refer to numbered Bibliography at end of article.

to the generally accepted terms, "mountain sickness," "seasickness," "train sickness," "auto sickness," "air sickness," etc., which are also universally regarded as harmless and temporary conditions, and are not indications of the presence of a permanent pathological state.

SYMPTOMATOLOGY OF ATHLETE'S SICKNESS

Athlete's sickness occurs most frequently after short-lasting exhausting performances carried out with the utmost expenditure of energy, such as after 220-yard, quarter-mile, and half-mile races (occasionally also after longer races, especially when they are concluded with a final spurt).

Approximately five or ten minutes after the exertion, the subject experiences a feeling of pronounced weakness, becomes pale, perspires profusely and complains of blurred vision, a throbbing headache, and nausea which is frequently followed by vomiting. A few minutes after vomiting has ceased, especially if the athlete has drunk water in the meantime, it is not uncommon for cramps to set in, usually in the calf-muscles. The mechanism of this symptom is probably explained by the extensive loss of chlorides by vomiting and by sweating, and the subsequent water intoxication (Talbott[41]). Occasionally there is slight bleeding from the oral, nasal and pharyngeal mucous membranes. This symptom, described for the first time by the author in 1930, and corroborated by Schmidt[38] in 1938, although not infrequently causing much anxiety to the athlete or his medical adviser, is actually harmless, and is of great theoretical interest in view of the patho-physiological relationship between athlete's and mountain sickness, in which latter condition similar hemorrhages are frequent (Y. Henderson[4]).

The entire syndrome lasts only a few minutes and leads to no serious sequelae whatsoever. The writer has observed numerous cases where athletes, almost immediately after an attack, have competed in one or more races with success, only to fall victim again to the same type of attack after each event. Observations, continued over many years, have conclusively proved to the author that delayed symptoms never occur.

In contrast to many other forms of breakdown encountered on the sports fields, athlete's sickness occurs, in the vast majority of cases, in healthy and highly trained athletes because it is only such athletes who are able to exhaust themselves to the limit of their physical abilities. As untrained individuals are usually unable to exert themselves to the utmost, they rarely suffer from athlete's sickness.

ETIOLOGY

There is reason to believe that there are three factors which exert an active influence on the incidence and severity of athlete's sickness: (1) warm weather, (2) fall of blood sugar, and (3) diminished oxygen tension of the atmospheric air.

The above three factors are probable interrelated in regard to their physiological effects. For didactic reasons, however, they will be discussed separately.

Warm Weather.—The importance of high external temperature became obvious to the writer when he noticed that he himself suffered more than usual from the above described complex of symptoms after racing on warm days. Moreover, on comparing the reactions of athletes under varying weather conditions, he noted that athlete's sickness occurred very much more frequently, and also more severely, on hot days. The author has also observed athlete's sickness in the course of working experiments carried out on human subjects in the heat chamber.

Various statements have been made in the physiology literature emphasizing the existence of certain relationships between heat and hypoglycaemia. Staub[40] has pointed out that the reaction of the body to a given quantity of insulin depends on the temperature of the atmosphere. Geiger,[3] through localized application of heat to the carotid arteries, produced a sudden insulin flow. Huxley and Fulton, and Olmstedt and Issekutz (both quoted by Staub[40]) found an almost corresponding increase of the insulin effect upon the blood sugar when the temperature of the room was gradually raised.

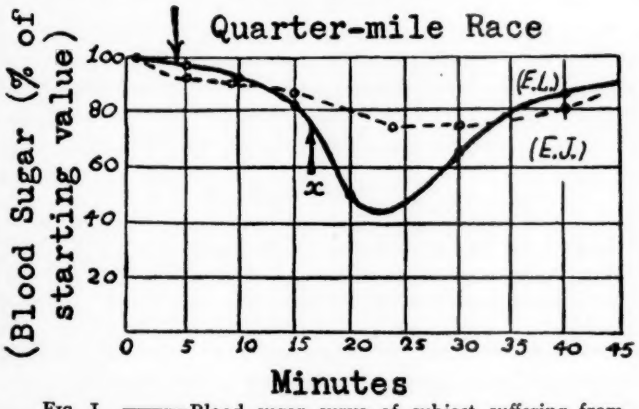

FIG. I. ——Blood sugar curve of subject suffering from athlete's sickness after quarter-mile race. - - - - - Blood sugar curve of subject showing uneventful recovery after quarter-mile race. *X*—vomiting.

Hypoglycaemia.—In 1933, the author reported three cases in which he succeeded in obtaining series of blood sugar determinations in runners *during and after* attacks of athlete's sickness. In these instances, he found hypoglycaemic phases which, like the clinical manifestations of the condition, were of short duration. (See Fig. I.)

Schlomka[37] also expressed the opinion that certain breakdowns

of athletes, such as were described by the author, are due to short-lasting hypoglycaemic phases. Jahn,[10] in the course of his investigations of so-called "psychasthenic" individuals, found that this group of persons who, as it were, suffer from a "vegetative idiosyncrasy," often react on physical performances of slight intensity with the syndrome of athlete's sickness which would occur in healthy sportsmen

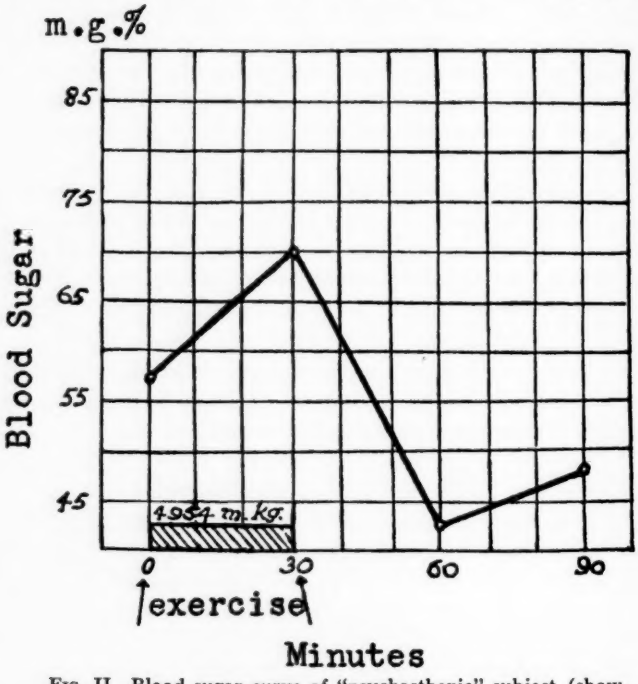

FIG. II. Blood sugar curve of "psychasthenic" subject (showing excessive vegetative response) suffering from symptoms similar to those of athlete's sickness after exercise of little intensity (note again hypoglycaemic reaction).

only after intense exertion. An examination of their blood sugar concentrations revealed hypoglycaemic reactions. (See Fig. II.)

Short-lasting hypoglycaemic phases which disappear spontaneously, that is, without any treatment, cannot be due to an exhaustion of the carbohydrate depots of the body, such as occurs after strenuous athletic performances of long duration (Jokl[15]). One has, therefore, to assume that disturbances in the regulatory faculties of the vegetative system might be responsible for such sudden and short-lasting hypoglycaemic reactions.

Quite recently Meythaler and Wossidlo[33] were able to make certain physiological observations, which, so they stress, strongly support the pathogenetic interpretation given nine years ago by the writer when he

originally described athlete's sickness. These workers found that physical exercise, particularly maximal performances of short duration, led to a sudden increase of adrenalin secretion into the blood, and held that the latter reaction is a typical physiological phenomenon accompanying every muscular effort of a certain magnitude. (See also Jokl[12].)

In beginners and in poorly trained people, Meythaler and Wossidlo found a great increase of the adrenalin contents of the blood after physical performances, while in highly trained athletes there was not only no increase, but actually a decrease of adrenalin after exertion. It is of great theoretical importance that in 1934 Holmquist[8] discovered an excess amount of adrenalin in the blood of patients suffering from acute mountain sickness.

In a second paper, Meythaler[34] went so far as to say that it is the exhaustion of the circulatory and muscular systems which limits the performances of the untrained, while it is the exhaustion of the sympathetic and adrenal system which primarily leads to the breakdown of well-trained sportsmen. There is little evidence available to support this rather sweeping statement.

Decrease of Oxygen Tension in the Atmospheric Air.—The possibility that a relative lack of oxygen might be a factor in the genesis of athlete's sickness must be carefully considered. The entire clinical syndrome of athlete's sickness is very similar to that found in certain forms of mountain-sickness.

Several decades ago von Schrotter,[39] Kronecker,[24] and Zuntz and collaborators,[44] maintained that the occurrence of mountain sickness is directly or indirectly due to the decrease of oxygen tension in the atmospheric air at high altitudes. Loewy[26, 27] stated that symptoms of mountain sickness occur when the oxygen *consumption* of the body has exceeded the oxygen *offer*. In 1901, Zuntz, Loewy, Müller and Caspari wrote unmistakably in their well-known monograph on "High Altitude and Mountain Climbing":

> Symptoms occurring after athletic performances carried to the point of exhaustion, are the same as those of mountain sickness, since the cause is the same in both cases.[44]

In 1927, Moritz made a similar statement:

> If physical performances are carried out at a high altitude (4,500 to 7,500 feet and over) the specific effects of the altitude, apart from the muscular strain, have to be taken into consideration. Thus an additional burden is put upon the organism. The extra effort can lead to abnormal symptoms: embarrassing signs of mountain sickness, such as breathlessness, headache, vertigo, extreme fatigue, and sickness set in. The most important factor operating at such altitudes is the considerable decrease of atmospheric tension.[35]

In a recent monograph dealing with the physiological and pathological effects of high altitude climate, Keys[23] strongly emphasizes the "marked deterioration of condition following exercise of any descrip-

tion observed in individuals suffering from acute mountain sickness."

He maintains that this reaction is due to the sudden increase of the oxygen requirements of the tissues. Thus "exercise of slightest intensity may lead to headache and vomiting."

The writer can quote numerous personal observations which demonstrate that definite relationships exist between high altitude and those physiological processes which lead to the occurrence of athlete's sickness. In Switzerland (at Engadin and Graubunden), he noted that after trivial physical performances, attacks of athlete's sickness occurred, which at sea level would almost certainly have only taken place after athletic performances of a much greater magnitude.

Johannesburg, as is well known, is situated at almost 6,000 feet (1,900 metres) above sea level, approximately the same altitude as Arosa. A fact which has struck the author is that athlete's sickness occurs more frequently in Johannesburg than at places, either African or European, situated at sea level. A number of American and British athletes experienced their first attacks of athlete's sickness while competing in Johannesburg, whereas they had never before suffered from this condition although having participated in many competitions in other parts of the world.

Similarly, he saw exceedingly severe attacks of athlete's sickness occur in competitors who had come from coastal towns, such as Durban and Capetown, to compete at athletic meetings held in Johannesburg. On the other hand, it was impressive to observe that the resistance against athlete's sickness of sportsmen who were domiciled in Johannesburg was increased when competing at coastal places. Three members of the athletic team of the University of the Witwatersrand, which the writer accompanied in 1935 to the National Championships at Durban, were astonished when they did not suffer from athlete's sickness, which condition they had almost always experienced after analogous performances in Johannesburg.

VASOMOTOR COLLAPSE

As has been mentioned before, vasomotor collapse, the most characteristic symptom of which is *loss of consciousness,* presents a clinical picture which is entirely different from that of athlete's sickness. Apart from its symptomatology, the causes of vasomotor collapse, the functional mechanism of its occurrence and its prognosis are entirely different. The question of treatment which can be lightly dismissed in the case of athlete's sickness must be carefully considered in every case of vasomotor collapse. Although it is true that vasomotor collapse does not always indicate the presence of serious disease, it would be entirely wrong to neglect a thorough diagnostic analysis in cases where this phenomenon occurs in first class athletes. In fact, the writer has presented ample scientific evidence to indicate that even a very good stand-

COMPARISON BETWEEN ATHLETE'S SICKNESS AND VASOMOTOR COLLAPSE

Manifestation	Athlete's Sickness	Vasomotor Collapse
Incidence—General Athletes	Rare Common	Common Rare
Duration	Short (few minutes)	Varies considerably
Subject	Healthy fully trained athletes	Suffering from impaired health, "staleness," malnutrition, etc.
Exciting factors	Heat, exertion, high altitudes	All influences which lead to generalized vascular dilatation
Causative factors	Marked exertion of short duration	Infections, heart disease, constitutional and other abnormalities, abnormal environment, etc.
Postural influence	None	Marked
Prognosis	Excellent	Doubtful or poor, according to cause
Treatment	Nil	Imperative
Resuming athletic activity after attack	Always possible	Inadvisable. Mostly impossible
Latent period between work and attack	Several minutes	Varies considerably. Mostly few seconds only
Unconsciousness	Never	Almost invariable
Nausea and Vomiting	Always	Uncommon
Recovery	Rapid	Slow

ard of athletic ability does not prove the absence of abnormalities, deficiencies or even of gross organic disease of the circulatory system (Jokl,[17] Jokl and Melzer,[20] Jokl and Suzman[21]).

The symptomatology and the patho-physiology of vasomotor collapse (in relation to and also apart from exercise), has in the author's opinion not yet received sufficient consideration in the literature, and will form the subject of a separate communication.

CONCLUSIONS

Medical practitioners who are actively interested in sport, as well as coaches, "physical culturists," and others associated with athletics and sport, should be well acquainted with the differential diagnosis between athlete's sickness and vasomotor collapse. They should know the causes and symptoms of these two conditions in order to understand their entirely different significance. They must be aware that athlete's sickness is a functional disturbance of short duration which, however unpleasant it might be for the moment, does neither justify anxiety, necessitate treatment, nor call for special precautions for the future. On the other hand, vasomotor collapse must invariably be regarded as a potentially serious event, possibly indicating the presence of a pathological state. After vasomotor collapse, the sportsman must be advised to discontinue training for a few weeks at least, and resumption of his athletic activities must be made dependent upon special permission given by an expert medical adviser, after carefully considering the findings of a complete physical examination.

Hitherto, athlete's sickness and vasomotor collapse have not always been correctly diagnosed. The sportsman who reports to his doctor about symptoms of athlete's sickness a day or two after the attack is frequently told that he is suffering from "indigestion," from "inflammation of the stomach," from "heart failure," from "athlete's heart," from "growing weakness," and so on. In many instances, such erroneous diagnoses have led to the over-anxious medical adviser totally prohibiting his "patient" from further physical activity. On the other hand, vasomotor collapses have often been regarded as harmless "spells of faintness," and the necessity of making a thorough diagnostic analysis has not always been appreciated.

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The Status of Student Health Programs in Negro Colleges, 1938-39

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PROGRESS has been made in the health status of the Negro in the United States, but this has been little when contrasted with that made by the white population and evaluated in the light of the extent, magnitude, and variety of his health problems. A consideration of a few random statistics is all that is necessary to support this oft-repeated statement.

The mortality rate of the Negro at present is from 30 to 40 per cent higher than that of the white population. The most pronounced differences, however, are found in the ages between 15 and 25 years. At this level, the death rate for colored boys and young men is nearly two and a half times that for the whites, and the rate among young colored women is more than three times that for young white girls.[1*] Progress in the reduction of this mortality has been very slow. In a recent study by Gover,[2] in which the general mortality rates for white and colored groups are compared for the periods 1921–24 and 1931–33 in ten southern and northern states, it is shown that these rates have decreased 2.5 per cent for the colored and 7.7 per cent for the white population.

This higher mortality necessarily shows itself in a lower expectation of life. A white baby born today may expect to live 65.2 years if it is a female, and 61.5 if a male.[3] Contrasted with this, we find that the latest reliable figures show the expectation of life for the Negro newborn to be 47.5 and 49.5 for male and female respectively. What is most startling, however, is the fact that since 1920 the Negro male between 20 and 50 years of age has lost on the average of three years in his expectation of life at every age.[4] This same loss holds true for the Negro female. The white group, on the other hand, has also lost in this age period, but this has been less than one year at any age period.

When we turn our attention to mortalities from specific causes, we are confronted with the same inequalities and snail-paced progress. The captains of death in the Negro population are heart disease, tuberculosis, pneumonia, syphilis and gonorrhea, and diseases of maternity and infancy. The death rates of these major conditions when compared with those of the white group show a disproportion in many instances of as

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* Superior figures refer to numbered Bibliography at end of article.

high as ten to one. Tuberculosis, for example, is considered the seventh cause of death in the United States; yet in most Negro communities, it is the first or second on the list. The greatest disparity between the two groups for this disease is found in the younger years. Among the female group in the ages from 10 to 14, the ratio of colored to white is 8.6 to 1, while in the male between 15 and 19, it is 7.1 to 1. Here, again, it is seen that the young Negro adolescent is at a great disadvantage.

Syphilis, "The Great Killer," is another example. Parran[6] has often said that in this country approximately six times as many Negroes have this disease as white individuals. Many Wasserman surveys throughout the South have demonstrated a prevalence ranging from 9 per cent in Albermarle County, Virginia, to 39 per cent in Macon County, Alabama.[7] Findings of the recent premarital examination requirements instituted in many states show this disproportion. In the city of New York, during the first six months of the enactment of the law, of the total white applicants examined, .61 per cent were positive as compared to 9.8 per cent for the Negroes tested.[8] Even the comparison of college groups demonstrate these inequalities. In a study by Tumbleson and Ennes,[9] it was found that reports on 2313 blood tests given in 11 Negro institutions showed positive reactions in 26.8 cases per 1000 individuals as compared to 1.99 per 1000 in 78,388 tests given to students in 516 white colleges. Here again, it must be emphasized that the venereal diseases have their highest attack rate in young adults between the years of 16 and 30.

Endlessly this presentation could be unfolded and the ultimate and inescapable conclusion would be that the health of this one-tenth of the nation, particularly of that group made up of adolescents and young adults, needs to be markedly improved.

What then are the causes for these glaring inequalities? The answer which has been repeatedly stated consists of three parts. First, throughout this country there is a dire need for facilities and sufficient competent health personnel to give adequate services to Negroes. Secondly, the low socio-economic status of this minority group contributes markedly to its unfavorable health situation. Finally, the paucity of effective health education in this group plays an important part in its mortality and morbidity experience.

Of these three contributing factors, the last appears to be of greatest import particularly as it applies to a small yet very important segment of the Negro population—the 40,000 college students in Negro institutions of higher learning. It has been said that approximately 6 per cent of the population of the United States have attended college and 2.4 per cent are college graduates; yet 50 per cent of the positions of influence and leadership in the life of the people are occupied by college men and women.[10] If this also be true for the Negro population, then it may be assumed that the proper nurture in health education of these

young people who spend from four to six years of their lives within cloisters of learning should produce leaders with the proper health perspective, ideals, attitudes and visions, who will be able to formulate, mould, and direct public opinion on health matters. It seems to us that the achievement of the other two goals, namely, better health services and improvement of the socio-economic level, must depend heavily on the effective health education of this segment. The Negro youth who will eventually be a teacher in a one-room school in Summerville, South Carolina, or a clinic physician in a large plantation on the Mississippi Delta, or a minister in the Piney Woods of Georgia, if he has been thoroughly imbued with health knowledge and has been taught full appreciation for good health habits, attitudes, ideals, and good community health, will certainly work diligently for more well-equipped and approved hospitals, more and better trained physicians, nurses, and dentists, improvement of maternal and child welfare programs, healthier working facilities for his brother in industry, and bigger budgetary allowances for health departments in his community.

What then are Negro colleges doing to meet this responsibility? It is well therefore for us to turn our attention to a consideration of the present status of student health activities in Negro colleges. In order to have an answer to this query and also to stimulate the development of student health activities in Negro colleges, the National Tuberculosis Association in December, 1936, and subsequently the American Social Hygiene Association in 1938, began making annual grants to Howard University. We set as our primary task the investigation by personal inspections of a representative sample of Negro colleges, and so in the school year 1938–39, 51 Negro institutions scattered in 15 states were personally visited in order to study their health programs and inspect their facilities. The discussion which follows is based on the analysis of the reports of these 51 schools.

ORGANIZATION

It has been repeatedly stated that the organization plan which comes nearest to insuring the development of an adequate health program is the one wherein the various divisions engaged in health work are grouped under a single administration. This plan as stated by Diehl[11] "centralizes responsibility for the health program in one individual, and if the head or director of this unit is a competent executive and a man of vision, a satisfactory coordination of activities and complete health program is almost certain to be developed, and numerous economies of effort and of funds should result."

This pattern is not commonly followed in Negro institutions. Of the 51 schools investigated, only 13 had a single department in charge of health and physical education. The most common administrative practice in these institutions is that of two separate divisions, generally with very little coordination between the two, with one in charge of

physical education and hygiene, and the other concerned only with the medical supervision of the student body. Furthermore, in such an organization, it is found that as a rule the former has full academic status while the other has not. This situation would be passable if there were in these schools with separate divisions, faculty health committees which would coordinate these activities and integrate other departments into a comprehensive health program. Only approximately 25 per cent of the schools visited have a faculty health committee, and in only a very small number of these were these bodies functioning, alert, and serviceable groups, rather than paper organizations. From this brief consideration, it is seen that presidents of Negro institutions will have to turn their attention to the development of better administrative units if they hope to achieve the greatest good.

HEALTH SERVICES

The student health service is admittedly an important phase of the college health program. The entrance health examination, defense against quackery, good personal habits, appreciation of good medical services, and the early treatment of incipient and minor illnesses are generally instilled into the student by association with a well-organized health service.

The 51 schools employed, in 1938–39, 47 part-time physicians, 2 part-time and 19 full-time nurses. It is immediately apparent that there is need for an increase in personnel in order to meet the accepted standard of student health practice. The acuteness of the situation is emphasized when the facts are scrutinized more closely. Eight of the 51 institutions have neither a physician nor a nurse to take care of student illnesses and health problems. In only one of the institutions with an enrollment of 500 or more students was a full-time physician employed. The outlook becomes even darker when the availability of medical consultation on the campus is considered. Only in a little over half of the schools visited does the physician spend any time on the campus so as to be able to see ambulatory students who are ill, or to hold follow-up conferences. In other words, the schools which state that they employ a part-time physician all too often mean that he is employed only to perform the entrance health examinations.

The school which assumes the responsibility of the health care of its student body must provide facilities for rendering it. This is just as important as providing laboratory and space equipment for the chemistry department. A good health service should have a dispensary where examinations, consultations, follow-up and minor treatments are given; an infirmary facility where students with minor illnesses may be admitted for a short period of time; and hospital connections, either official or semi-official, where individuals with more serious illnesses may be confined. Ideally, the dispensary and infirmary with a certain amount of necessary equipment should be centralized in one unit with

provision for toilet and lavatory facilities, and rooms for isolating students with communicable diseases.

There is need for such units in Negro schools since many of them have dormitories which are quite often overcrowded and wherein, in many instances, two or even three students share the same bed. In addition, many are located in southern communities where hospital and medical facilities are sadly lacking. However, investigation of this phase of the program shows certain inadequacies. Of the 51 schools, only half had dispensary units, a third had men's infirmaries, and only eight of the total number were affiliated with or had hospitals of their own. The availability of dispensary and infirmary care in the small schools is very meager, but this is just a graver expression of the situation which exists in the larger schools.

The equipment of the dispensaries and infirmaries leaves much to be desired. In one school, this consisted solely of a room with table and cabinet, and with floor area so small that students have to remain standing while the physician is giving treatment or advice. In another, the school physician ministered and advised students in a room adjoining the gymnasium with not even a pair of scales to weigh students. This also was true of many of the infirmaries inspected. Outside of beds, little or no equipment was found in them.

HEALTH FEE

It is an accepted fact that the individual health fee should be the largest contributing source of income for financing student health work. This, however, does not appear to be the case in Negro schools. In a little over half of them is a health fee charged. Of these 27 institutions, 18 charge less than $4. This is lower than the usual fees of either $5 or $10 assessed in white schools. Thus, it may be seen that health fees do not contribute much to the financial support of health services in Negro institutions. The reasons for this situation may be explained on the basis that Negro students on the average are poor, and therefore, an attempt is made by administrators to have the tuition and other fees as low as possible so that student enrollments will not in any way be curtailed.

Thus, many of the deficiencies which are set forth in this paper are in part functions of the budgetary allowances which are made for the health and medical care of students.

HEALTH EXAMINATIONS

The health examination is possibly the most important procedure in the college health program. Through this medium, both the individual student and the university community are protected. By the discovery of physical handicaps, preclinical conditions, and poor hygienic habits the individual may be advised and much future physical damage may be avoided, while through the discovery of communicable diseases,

such as tuberculosis, syphilis, gonorrhea, and athlete's foot, widespread involvement of the student body is prevented.

The present study shows that 39, or 80 per cent, of the schools offer certain types of health examinations to their student bodies. The schools which are most delinquent in this phase of the program are those belonging to the class with an enrollment of less than 300 students since here it is found that almost half do not offer health examinations. The majority of the 39 schools complete the examination of the student during the first four weeks of the school year. The desired ideal of performing this before the beginning of the school session is achieved in only three of these schools. Interestingly enough, when these institutions are divided according to groups of students who are the recipient of the examination, it is found that the colleges are equally divided into those which examine all of the students yearly and those which limit this activity to new entering students alone. As a general rule, it may be said that when all the students are examined yearly, this is poorly done and has very little value.

The health examination in order to be of value should be thorough and in the opinion of the writer should include the following five basic procedures; namely, the tuberculin test, X-ray of positive reactors, blood examination for syphilis, urine analysis, and the examination of the eyes for visual acuity, this latter being of particular importance at this level. In only one of the 38 schools for which complete information is at hand are all of the basic procedures included in the health examination, while in 18 per cent none of these items is part of the health appraisal. About an equal number of schools include one, two, or three of these measures. It is of interest to note that the procedure most frequently included is the blood examination.

In addition to these glaring omissions of basic procedures, it is found that the physical examination itself in almost 50 per cent of the schools is of poor quality. After observing various record forms and talking with physicians in charge of these activities, one is impressed with the superficiality of these performances. In many instances, the medical history is lacking. In too many, the examination is only an inspection and in several schools, the blood pressure is not even taken. One wonders why physicians presumably with scientific training will yearly carry out such face-saving procedures. Admittedly, they receive very small compensations for their services, and therefore cannot devote much time and energy to the work; yet in many instances, it appears that with better organization, much more could be accomplished.

RECORDS

Since the student spends from two to four years in college, it is the responsibility of the school to keep a complete health record of every individual so that each illness may be understood in the light of previous ailments and every contact with the health service will

be recorded. Health authorities are also of the opinion that "a unit record system" whereby all information pertaining to the health of each student, kept in individual folders or envelopes, should be used. Negro institutions, as may be surmised, keep few records, and these as a rule are poorly kept. Of the 34 schools which had forms, about 70 per cent keep only one; namely, the physical examination schedule. Twenty per cent of these used 2, and only 10 per cent had reached the high mark of 3 forms. Consultation, infirmary, parent notification, and other records are sadly lacking. In many schools, consultations are noted, but these are written chronologically day by day in a notebook. In some, even this is not done, and only the medicines dispensed without names or reasons for giving them are recorded. Unit record systems are not the mode in these institutions since only 4 of the 34 schools had adopted this practice in 1938–39.

HEALTH INSTRUCTION

Preparation for full and happy living has been one of the more important trends in modern education. Thus, it has been emphasized that health teaching should be an integral part in the curriculum of every college and university. This study shows that there is need for better organization and greater emphasis on health instruction in Negro schools. One finds no unanimity of opinion as to what department shall have charge of this important responsibility. In 52 per cent of the schools, this was placed either in the department of health and physical education, or physical education; in 30 per cent, it shifts yearly from one department to another; and in 12 per cent, the physician or nurse, without relationship to any academic department, has charge of the hygiene teaching. In this connection, it may be stated that in the majority of the colleges the physician takes very little interest or active part in the formal teaching of health courses.

Health instruction, like all other educational processes, to be effective should be so available that there will be opportunities for repeated exposures. In 1938, only 80 per cent of the schools offered health courses. Of these, 45 per cent offered only one course, 35 per cent had two, and the rest, or 20 per cent, offered three or more courses. Although admittedly this is not a bad showing when compared to white schools of comparable enrollment, yet there is room for improvement in this phase of the program.

Of particular significance in this discussion is the availability of required health courses in the curriculum of these institutions. It was the consensus of opinion at the Second National Conference of College Hygiene that there should be in all institutions a required credit course in hygiene of not less than two semester hours. Of the 51 schools investigated, in only 15, or about 30 per cent, is a course in health compulsory for first year students. Although the schools with required courses seem to be doing a commendable job, yet it is regrettable that there is such a paucity in the number of colleges with this requirement.

SANITATION

Those who are familiar with methods in public health know that the initial health activities resulting from the early scientific observations were environmental. However, we notice that in Negro colleges and universities this facet of the health education program is woefully neglected at present.

The sanitation of food and the environment in which it is prepared is of primary importance in a university community and may be taken as the first example. In only 7 out of 21 schools were facilities available to food handlers for washing their hands. On questioning, it was found that in the great majority of these institutions no attempt was made to require that all food handlers wash their hands before serving meals. Screening of windows was found in practically 80 per cent of the schools; but even so, flies were present in many kitchens and dining rooms, due either to faulty screens or carelessness in the closing of doors.

The food handler's examination is of some value in this program. Yet, here we find that of 48 schools, only 29, or 60 per cent, required a health examination of their food handlers, but of these, only 11 required that all be examined. The rest were satisfied with the examination of only the student helpers. Why the cook, dietitian, and non-student helpers are not examined in a great number of schools is difficult to explain. The quality of these examinations is not much better than that generally given to the student body as a whole. In many instances, the examination merely consists of physical inspection. In very few schools are throat and stool cultures done when indicated; while the search for tuberculosis by routine flat chest X-ray is seldom included.

Before leaving the subject of food, a word should be said about the status of nutrition in these schools. Although here again the sampling is not large, yet certain deficiencies may be noticed. In only 13 of the 29 institutions could the meals regularly served to the students be considered as well balanced. In a goodly number, the meals were too often lacking in protective foods and consisted of a super-abundance of carbohydrates. The following sample meals from our investigations vividly bring out this point.

Mid-day Meal: Bologna sandwiches and tea
Evening Meal: Creamed potatoes and apple sauce
Mid-day Meal: Beans, cornbread and apple pie
Evening Meal: Bread, salmon croquettes, dressing, spaghetti, and beans

Milk is not freely available. In only 8 of 25 schools was this "most perfect food" served to students three or more times per week. Of interest, also, is the fact that in eight of the schools visited, the milk served was not pasteurized, and quite often, the harvesting of this easily perishable product violated established sanitary principles.

The sanitary conditions of the dormitories is also of special significance. The conditions in the men's units were appalling and in many instances suggested medieval practices. Dirty sheets and pillow cases, dirt and trash in the hallways and rooms, poor plumbing in lavatories and toilets, ill-kept shower rooms are too often found on the men's side of the campus. Women's dormitory rooms are generally much better kept. The reason for this difference is simply one of lack of effective supervision through rigid regular inspections. Where this is equally enforced in both the men's and women's dormitories, such marked differences in the general cleanliness and upkeep do not exist.

Lighting presents a very acute problem in Negro schools. In practically all, the quality and quantity of light are inadequate. In many dormitories, light is obtained only from a central ceiling bulb of low wattage. In many schools, students do not have any desk lamps, and those who possess such have them for adornment rather than for use. In a few institutions students do not have desks and are forced to study sitting on the sides of their beds. In addition in a number of colleges, the practice is still in force whereby all lights except those in the halls are turned off either at 10:00 P.M., 10:30 P.M., or 11:00 P.M., and students desiring to study must do so in the halls. This practice must be condemned as undesirable in a college environment.

Another item which is of concern is the problem of crowded dormitory facilities. In only eleven of the men's and sixteen of the women's dormitory systems were all the rooms occupied by the normal number of two students. On the other hand, in the ten remaining men's and eight women's units for which we have information, one finds in certain sections or even in whole dormitories three and more students sharing rooms meant for two. Of greater concern is the fact that in a number of schools there are rooms where two and even three students sleep on the same bed.

The final factor which further supports the contention that this group of institutions are as yet not aware of their sanitary responsibilities is seen in the fact that of 49 schools for which we have information, only 10 or about 20 per cent make an annual sanitary survey. Thus in many institutions, no attempt is made to determine yearly the condition of dormitories, light, ventilation, heating, campus cleanliness, garbage and sewage disposal, fire traps, hazards in the gymnasium, and the sanitary conditions of eating establishments which are frequented by their students.

SUMMARY AND CONCLUSION

This summarization of the conditions existing in 51 colleges in the school year 1938–39 shows conclusively that certain health activites are lacking in the majority of these institutions and that the reasons for these deficiencies may be summed up as follows:

1. Lack of interest on the part of college administrators.
2. Lack of sufficient budgetary allowances.
3. Lack of trained personnel.
4. Lack of effective organization.

The apparent lethargy of many presidents and administrative officers in matters relating to the improvement of the hygiene teaching, medical supervision of the student and the sanitation of the environment is the primary obstacle which must be overcome. College presidents must come to the realization that educating the student to meet certain requirements for a degree or certificate also carries with it the responsibility that the student will live in as healthy and clean environment as possible, that he will have a good measure of health protection, and that he will have an opportunity to improve his health habits and attitudes. The school is a community institution. Whether governmental or privately supported, funds are derived from the community. For such an investment, the community demands that when a student again returns to it after a period of four, five or six years, he should be an asset of the highest order. He who graduates with tuberculosis and has transmitted it to three or four student contacts in the college; or the individual with syphilis who has not been discovered, or the one who because of faulty habits and attitudes will later develop a serious degenerative disease and die prematurely is not a good investment. The college administrator who fails to meet this responsibility is not fully discharging his trust to the community.

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The Factor Analysis as a Research Technique

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FROM time to time new techniques for research are devised. Not infrequently these techniques open up new areas within which studies may be projected, and make possible the solution of problems which could not have been successfully attacked prior to the development of the new method. The introduction of correlation and multiple regression techniques of statistical analysis into physical education, about 1919, is an example of the stimulus given to research by such newly-devised methods.

Another type of statistical analysis which has fairly recently come into use is what is usually known as the *factor analysis*. In 1927, Charles Spearman[1] proposed a method of analysis which would enable the investigator to analyze a battery of tests of measured abilities and to separate each test into two categories: (1) the part of the test which was due to what Spearman called a *general factor*, and (2) the part of the test that was *specific* to that test alone. Spearman, a psychologist, postulated the existence of what he called "general intelligence." This general intelligence, or the ability to attack abstract problems, was supposedly supplemented by certain specific abilities which might be peculiar to any one test or trait. Shortcomings were soon discovered in this method, namely, the existence in a great many abilities of more than one factor of the type Spearman called the general factor; that is, the ability being measured had more than the one factor that was common to all of the tests although this factor was not present to the same degree in each test. Where some but not all the tests were more or less duplicates, as for example, several strength tests in a battery of tests of motor educability, the so-called "specifics" tended to be present in a number of tests items, but were not common to all. For these problems Spearman presented no solution. These deficiences of the Spearman method led to a further attack upon the problem. While a number of names might be discussed in this connection, we shall limit the discussion to the methods proposed by two investigators, for all the others at the present writing are minor varieties of these.

Between 1931 and 1933, L. L. Thurstone[2] of the University of Chicago devised a method for solving such problems, by which any number

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1 Charles Spearman, *Abilities of Man* (New York: Macmillan Company, 1927).
2 L. L. Thurstone, *The Vectors of Mind* (Chicago: University of Chicago Press, 1935).

of general or group factors may be isolated. He further refined these methods, and in 1935 published a revision which is at the present time the one most generally used in the educational field.

In 1933, Hotelling[3] developed a similar method which was, however, considerably more time-consuming in the computation but which with proper manipulation could eventuate in approximately the same results. Hotelling's approach has been primarily a mathematical one, and his concern has not been particularly with practical application of the method. The presentation in this paper will concern itself primarily with the Thurstone techniques and their uses. The Hotelling methods will be discussed only in connection with the problems of "rotation" in this type of research (*vide infra*).

WHAT IS A FACTOR ANALYSIS?

A factor analysis is simply another method of correlational research. It begins with a complete set of intercorrelations of all the variables to be studied. A successful analysis eventuates in the isolation of a number of *factors* or components which constitute the major part of the tests analyzed, and gives correlations between each of these factors and the individual variables or test items.

For purposes of illustration an analogy may be drawn between the factor analysis and a chemical analysis. Let us select a number of organic compounds and write their formulas without regard to the molecular structure or their submolecular groups (see Table I):

TABLE I

$C_{12}H_{22}O_{11}$	Cane sugar
$C_6H_{12}O_6$	Dextrose
$C_6H_{10}O_5$	Starch
C_2H_6O	Alcohol
H_2O_4S	Sulphuric acid
HCl	Hydrochloric acid
$C_{20}H_{24}O_2N_2$	Quinine

Hydrogen, which is common to all these compounds, would correspond in a factor analysis to a *common* factor. Oxygen, which is common to six of the compounds, and carbon to five, might, technically speaking, be called *group* factors; that is, they are common to a *group* of variables, but not to all. On the other hand, sulphur, chlorine, and nitrogen, which are present in only one compound, would in the terms of the factor analysis be spoken of as the *specifics*. Let us now think of these factors and specifics in terms of physical education test variables. In most athletic activities, strength, or the ability to apply force, is present to a fairly high degree. *Strength,* then, might correspond to hydrogen as given in the example in Table I. *Velocity,* or the ability to move the parts of the body with great rapidity, might be present in most of the

[3] H. Hotelling, "Analysis of a Complex of Statistical Variables into Principal Components," *Journal of Educational Psychology,* 24 (1933) 417–441.

athletic activities, as in track and field events, but be absent in a few, such as strength tests. This factor might correspond to carbon in Table I. *Dead weight,* or the part of weight other than muscular, would be another factor which would affect all of the track and field events, and such a strength test as the leg lift; but it would have no effect upon such a strength test as that of grip strength. This factor might correspond to oxygen in Table I. Certain of the athletic events might depend upon some specific quality; for example, success in the high jump is partly dependent upon the relative length of the legs; success in the shot-put is partly concerned with the width of the shoulders; and the ability to do some other event might be primarily dependent upon some other specific ability. These items would correspond to sulphur, carbon, and nitrogen in Table I. In a factor analysis only the common and group factors appear, while the specific factors are completely unaccounted for so far as isolating or measuring them is concerned.

SOME FUNDAMENTAL CONCEPTS

A *factor* may be thought of as an elemental component of a group of tests, in which concept the factors are completely independent and *not correlated each with the other,* just as hydrogen and oxygen are independent; and just as the latter may unite to form water, so these factors may combine to form a compound. It should be emphasized that in any given factor analysis the factors which go to make up a given battery of tests may be so completely combined as to render it impossible to separate them. Hence it may appear as though these factors are not independent and uncorrelated. Further study, however, and experimentation with additional tests carefully selected will usually make possible the separation of these combinations of factors. To continue the chemical analogy, the combination of factors appearing in a factor analysis would correspond in a chemical analysis to the compounds having the hydroxyl radical, such as $C_2H_5(OH)$ (alcohol), or the organic acid $COOH$ radical, such as in $C_5H_4N(COOH)$ (nicotinic acid). This analogy breaks down if examined too closely, for if one puts into the test battery individual test items which contain but one of these "radical" elements, then the individual factors separate and break down the radical. For example, if we analyze track and field activities, it will be almost impossible to separate strength and velocity. These factors appear as power. If, however, we put into the battery of tests to be analyzed a couple of strength tests and a test of pure velocity itself, it will now be possible to separate out strength and velocity in pure form in the track and field tests.

A "factor loading" is the correlation of the factor with each test item. The sum of the squares of all of the factor loadings for any given variable (or test) is called a *communality,* the square root of which will be the *multiple correlation* with all of the factors when they are used to predict this variable.

Any given variable may be accounted for by the various common or group factors, by the various specific factors which may be concerned with that particular variable, and by the errors. These errors may be ones of unreliability, or "errors" in the sense of differences of technique, etc. To illustrate, the running high jump might be composed of the factors of force, velocity of muscular contraction, dead weight, length of leg, and skill in performance, factors which might be common to a number of track and field events. In addition, there might be such specific factors as relative length of the lower leg to the upper leg. Errors might be due to unreliability, such as the well-known fact that a jumper is apt to do better one day than another. They might be due to differences in environmental conditions, such as having part of the group tested when there was no wind and having others tested when there was a considerable wind; and they might still further be due to the fact that some individuals use the form of the scissors jump while others use that for the western roll. If we denote common and group factors by *F* with appropriate subscripts, the specific factors by *S*, errors by *E*, the whole of a variable may be accounted for by the following formula.

$$F_1^2 + F_2^2 + F_3^2 + \ldots \quad F_n^2 + S_1^2 + S_2^2 \ldots$$
$$S_n^2 + E_1^2 + E_2^2 + \ldots E_n^2 = 1.00$$

The difference between 1 and the decimal obtained by the communality will represent the part of the test or variable unaccounted for by the common or group factors but does not in any way tell how much of this is due to specific factors and how much to error.

A geometric representation of a factor analysis which is completely valid may be obtained by plotting the factors at right angles to one another. It is feasible to show this representation in a diagram of only two dimensions. (See Figure I. The factor loadings are given in Table II.)

TABLE II

FACTOR LOADINGS FOR PLOT IN FIGURE I

Variable No.	Factor I	Factor II	*h*
1	.90	—.05	.90
2	.85	.10	.86
3	.60	.60	.86
4	.40	.70	.81
5	.50	.20	.54
6	.10	.90	.91
7	.00	.75	.75
8	—.05	.50	.50

Factor I may be thought of as force or strength, and Factor II as velocity. This is purely a hypothetical case assuming that Factors I and II are the only ones involved (which assumption is not apt to be true). We have indicated on the two axes the scale of factor loadings, or the correlations with the factors. To illustrate, Variable 4 would have

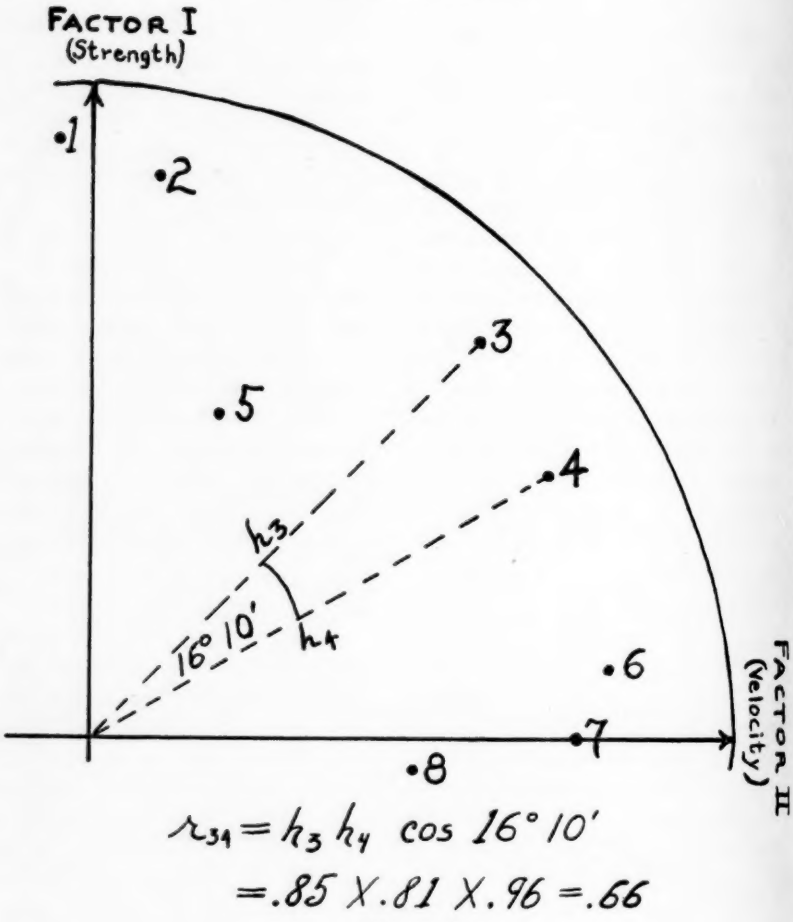

FIGURE I

a factor loading of .4 with Factor I, and a factor loading of .7 with Factor II. The diagonal, which we will represent by h_4, is the square root of the communality and represents the multiple regression of Variable 4 with Factors I and II. The same principles will apply to Variable 3. The correlation between Variables 3 and 4 may be represented by the following relationships:

$$r_{34} = h_3 h_4 \ (cosine\ of\ angle_{34}^{\wedge})$$

The angle is that between the two vectors h_3 and h_4. This relationship, which can be projected into any number of planes, can readily be visualized in three dimensions; when we pass into four or more dimensions, however, it is necessary to call upon the geometry of hyperdimensional space to understand how six or eight planes may each be at right angles to each other. This relationship is mathematically possible,

though in our three dimensional world not possible to visualize. Those who have not studied the mathematics of hyperdimensional space will either have to take this statement on faith or study the underlying mathematics!

When a number of variables are analyzed, one difficulty which appears is that when the variables first emerge in groups in space, whether this space be one, two, three, or hyperdimensional, they are not properly orientated into their actual factors. With the exception of the first factor which appears (in the temporary first factor), all the other factors distribute themselves around one or more orthogonal planes in such a way as to be evenly distributed on either side of these planes; that is, the plane runs through the approximate centroid of the tests. The tentative factors first obtained have to be *rotated* a number of times to obtain the true factor. One of the objections to this procedure is that it is sometimes subject to errors of judgment, which criticism is a valid one. The fact that this method is subject to certain errors of judgment is not peculiar to this method of research alone. Almost any method of research—statistical, historical, philosophical, and experimental—may be subject to the same type of error. The method merely needs to be used with caution (as does any other method) and with all possible care taken to avoid the most common sources of error.

This matter of rotation involves some of the controversies between Hotelling and Thurstone, Hotelling holding that rotation is unnecessary. The writer, after careful study, believes that the evidence, which has been amply discussed in another publication,[4] is completely on the side of the necessity for rotation. It should be pointed out that this method of rotation, which is best done by the so-called two-at-a-time method, is something that should be undertaken only by those who are expert in its use. As is true of other complicated tools of research, one needs a certain amount of training in this method before using it for research that is to be published.

To reduce the possibility of errors and to make it most probable that the rotations are correct, a number of precautions should be taken:

1. Use variables that are as simple and uncomplicated as possible. For example, one should never include large test batteries, such as whole cardiovascular tests, a fact which may be illustrated by the inclusion of the Schneider test, the McCurdy-Larson test, the Crampton test, the Foster test, and the pulse-ratio test as single variables. Such variables are too complicated to be readily broken down, and they are much more apt to act as radicals. There should be included as test variables in such a cardiovascular study the individual pulse rates (reclining,

[4] C. H. McCloy, Eleanor Metheny, and Virginia Knott, "A Comparison of the Thurstone Method of Multiple Factors with the Hotelling Method of Principal Components," *Psychometrika* 3:2 (June 1938).

sitting, and standing), the individual systolic and diastolic pressures, etc. It is not always possible to simplify a variable as much as we wish, but a good rule is to keep it as simple as possible.

2. Do not include direct measures and indirect measures, or quotients, in the same batteries to be analyzed; that is, if one is analyzing six strength tests and four track and field events, do not include in addition such derived scores as the P.F.I. and the Athletic Quotient. It would be highly probable that the results, so far as these two quotients are concerned, would be apt to be uninterpretable. They would not, however, ruin the results of factoring the other tests. A number of variables which may be thought of as direct variables frequently act as derived scores; for example, in analyzing strength tests, and track and field activities, if one were to include the *number* of chins and the *number* of dips, since these are so affected by weight and therefore resemble a P.F.I. much more than they do a strength test, one would be mixing direct and indirect scores. Hence one should be on the lookout for this source of confusion.

3. Try to avoid the inclusion of data from heterogeneous groups; for example, do not combine boys' and girls' scores in athletic events. It is wise not to combine data from two schools. We have found in some cases that the pupils from one elementary school taught by one teacher performed 20 per cent better than did other pupils from a neighboring school. This condition introduces sources of error which should be avoided if feasible.[5]

4. Think through as nearly as possible what factors you would expect to find, and include one or more variables which are as pure as possible in these factors; for example, in all track and field activities you would expect to find strength as one of the factors. If you include two or three strength tests, you would always have the axis of one of the factors located, which reference point aids greatly in rotation. You would expect that dead weight would be another factor, so you would want to include weight as a variable. The inclusion of weight does not completely locate the dead weight axis because both live and dead weight are present, but it does locate the plane which enables the axis to be located.

After rotation comes the problem of the identification of the factor, which is in some cases easy, as with strength and velocity; and which in some cases is so difficult that while we know that there is a factor present, we cannot positively identify it without further experimentation. In the latter case it may be well simply to number or letter the factor, but develop such hypotheses as one may well develop, and try them out in further studies.

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[5] If it is necessary to combine data of this type, the data may first be corrected by analyzing them for variance. See E. F. Lindquist, *Statistical Analysis in Educational Research* (Chicago: Houghton Mifflin Company, 1940).

WHAT CAN THE FACTOR ANALYSIS DO?

The factor analysis will not do everything which is discussed below in every study to which it is applied, and it should, of course, be stressed that the factor analysis is not necessarily the only method of accomplishing these things. It is, however, a convenient one and one which, in many instances, is practically the only feasible method that we now have. A consideration of the various possibilities may make clear the kinds of studies to which this type of correlational analysis may well be applied.

1. When analyzing properly selected variables, the factor analysis can isolate mathematically factors that cannot be readily isolated by experimentation; for example, it can separate dead weight from live weight.

2. The factor analysis can explore for new factors or elements. Suppose, for example, that one wished to analyze some such group of activities as ball games. He would first attempt to analyze subjectively these activities into their elements. He could readily think of such possible factors as strength, velocity, four or five types of educability,[6] dead weight, and perhaps others. He would then select test variables of one kind or another to measure these factors in as pure a form as possible. He would probably also put in as test variables certain game elements; for example, if he were analyzing football, he would include passing, punting, drop kicking, speed of charging, amount of energy the individual could develop in charging, ability to change direction, and other elements which will readily occur to the reader. He would then intercorrelate all of the variables selected and apply the factor analysis techniques. It is probable that not only most of the factors that he expected to find will come out, but also that others which he has not thought of will emerge. The problem then is to identify these factors, a process which may involve another factor analysis in which are included, in addition to the original variables which proved fruitful, a number of other variables which attempt to verify tentative identifications of the new factors. In this identification it is quite probable that some of the factors will be new ones for which we have no terminology; for example, in identifying factors of character, we frequently find components for which we have at present no concepts. Combinations of these components form traits for which we do have names.[7] The identification and naming of these new factors are fraught with no more difficulty in the field of physical education than in other fields. Experiments in nutrition resorted to the expediency of using letters to designate the vitamins, and only recently, as the vitamins

[6] C. H. McCloy, "A Preliminary Study of Factors in Motor Educability," *Research Quarterly*, 11:2 (May, 1940).

[7] For example, see p. 281 of C. H. McCloy, *Tests and Measurements in Health and Physical Education* (New York: F. S. Crofts and Company, 1939).

have been isolated chemically, have they received chemical names. The same difficulty exists in identifying and naming the hormones of the glands of internal secretion. Whoever in the history of chemistry discovered and named hydrogen faced the same problem. He probably found that hydrogen when combined with air produced water vapor, and hence coined its name from ὕδωρ (water) and -γενής (born).

3. The factor analysis may be used, as it were, to break up the molecule; that is, where a variable is somewhat complicated and composed of a number of factors, it is generally possible to isolate these factors and, to continue the chemical analogy, to break the molecule down into its atoms.

4. When the factors have been isolated, the factor analysis provides a means for their measurement. Whether we measure them in their pure form, or if desired, in the form of a compound or radical, they are *measured* in the sense that we get them in terms of their correlations with identified factors, or conversely how closely the factors correlate with the variable. It is further possible to combine these factor loadings with the intercorrelations, means, and standard deviations of the variables and obtain multiple and partial correlations and multiple regressions, which enable us to measure the factors rather completely. This measurement is, however, limited to measuring in terms of standard scores; that is, we cannot measure as yet dead weight in pounds, but we can measure the individual's dead weight in terms of standard deviations from the average dead weight of the group.[8] Although the problem has not as yet been solved, it is possible that this limitation may be sometime overcome. In many cases these standard scores, perhaps interpreted in terms of T-scores, may be completely adequate. A track coach, for example, who may want to measure the relative velocities of students (in pure form) can do so with great accuracy.

LIMITATIONS OF FACTOR ANALYSIS

1. Just as in a chemical analysis of a pure salt, all that the chemist can extract is sodium and chlorine, in like manner, if the only factors present in a given battery of tests happen, for illustrative purposes, to be force, velocity, and dead weight, those will be all the factors that will come out of the factor analysis. One should remember that these factors will appear *only if* they are present in *at least two* of the tests analyzed. Otherwise, the factor may act as a specific, which does not appear in the factor analysis. In this connection, the reader should keep in mind the fact that what may be a specific in one analysis may be a group factor in another. To illustrate, suppose that we were to analyze four tests of strength, such as those of right grip, left grip, push, and pull, none of which had any concern with dead weight. If we now added

[8] Aileen Carpenter, "An Analysis of the Relationships of the Factors of Velocity, Strength, and Dead Weight to Athletic Performance," *Research Quarterly*, 12:1 (March 1941) 34.

weight to this battery, the only factor that would appear would be force. Since about 40 per cent of weight is muscle, weight would then be correlated with strength. Dead weight would in this case have to be a specific since it is concerned only with the one test. If to this battery we were to add the running high jump, the 50-yard dash, and the 12-pound shot-put, and to re-analyze it, force would again appear as the major factor. In addition to velocity appearing as another factor, dead weight would also appear, being negatively correlated with the dash and the high jump, and positively correlated with the shot-put.

2. The crude or obtained factor loadings must be rotated before they are useful, a procedure which involves a certain type of skill and is subject to possible errors. If the rotations are incorrect, errors of interpretation will certainly follow.

3. As is true with other statistical devices, the results of the factor analysis are no better than the data upon which they are based. Data so carelessly gathered as to have a high degree of unreliability will be no more significant when factored than they would be if analyzed in any other way.

4. Because of the highly subjective element associated with rotation, this method is one in which guided experience is a prerequisite. The literature, particularly in psychology, is already full of very badly analyzed studies in the field of factor analysis, most of them badly rotated. This condition is no different from that in the use of other statistical methods. When partial correlation first became popular, the literature was full of inexpert correlational studies. This limitation is stated here only to encourage the prospective research student to be cautious about publication before he is adequately trained in this method of research.

The methods of factor analysis are yet far from perfect. One of the imperfections is a technical, mathematical one which will not be understood by the individual who has not done a factor analysis. It concerns the numbers that should be placed in the diagonals of the correlational matrix. This defect, however, together with the necessity of rotation, ordinarily will not affect the obtained factor loadings significantly. The differences between "true values," which might be obtained under ideal circumstances, and the actually obtained values are seldom greater than the differences in correlations obtained from different but homogeneous samplings. To make this statement clearer, suppose that the male student body of a university were to be divided into two chance halves. The same tests would then be run on each half and intercorrelated. The intercorrelations of the two groups would not be the same, and if they were factored, the factor loadings would be slightly different. The errors introduced by the lack of a correct diagonal value or by rotation are seldom greater than these differences. As the methods are further improved, we may expect these errors to diminish. At the present, however, they are not particularly significant.

Probably the greatest dangers in the use of this method are, first, that it may be misused by those who have not taken the time to master its techniques or understand its limitations; and, second, that it may be thought by certain zealots to be *the* method of statistical research. Hence, may I repeat in other words a statement made above, namely, that the method of multiple factor analysis is just another, but more complicated—and more potent—statistical variation of the principle of partial correlation. It lends itself to the accomplishment of a certain type of analysis not possible through the use of other techniques, but it has the limitations of all statistical methods in that it cannot transcend the limitations of the data to which it is applied, nor can it produce accurate results when inexpertly used; and there are many, many kinds of statistical problems to which it does not apply.

While the method of factor analysis was devised by a psychologist, like any other method of correlation it is applicable to numerous fields. It has been applied to: (1) numerous studies of motor skills, (2) the analysis of anthropometric data, (3) the analysis of cardiovascular variables, and (4) the study of character and personality traits. (See the bibliography for these studies and others to which factor analysis has been applied.) It is still rather early to predict what all the possibilities of such a method will be for physical education. Among other things, however, it should enable us to analyze the basic factors inherent in each activity and to know just what physical and other qualifications are required for successful performance in each activity, which knowledge should eventually give us better tools for guidance in our own field. In the field of character and personality there is already evidence that the utilization of the factor analysis may eventually give us a key for more easily unraveling emotional difficulties, a sort of mechanical psychoanalysis, as it were,[9] similar to a botanical key by which we identify plants.

The factor analysis should eventually not only offer us much help in the solution of pure science studies as we attempt to break down complex skills into their elements for better understanding, but there is a further possibility that it may eventually make real contributions to curriculum studies. If we know what common elements are required for certain types of activities, we may be able to see that these are included early enough in the course to supply the prerequisites for later learning. In all events, it is a technique that will repay intensive study.[10]

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[9] Emma McCloy Layman, "An Item Analysis of the Adjustment Questionnaire," *The Journal of Psychology*, 10 (1940), 87–106.

[10] To study the techniques of the factor analysis, the reader is referred to the appendix of L. L. Thurstone, *op. cit.* For a simpler discussion and for a discussion of rotation, see J. P. Guilford, *Psychometric Methods* (New York: McGraw-Hill Book Company, Inc., 1936), Chapter XIV.

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An Analysis of the Relationships of the Factors of Velocity, Strength, and Dead Weight to Athletic Performance

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RESEARCH students of the type of athletics that demands speed, such as track and field events, have expressed an interest in the relationship of a number of structural and functional variables to this kind of performance. Among these variables are muscular strength, velocity—or the ability to move the parts of the body at high speed—and the effects of over- and underweight. The advent of the statistical technique known as factor analysis into the available battery of statistical research tools makes possible an analytical attack upon these problems that formerly was not conveniently possible.

Data secured on 100 college girls included: normal weight;[1] 50-yard dash; broad jump; 6-pound shot-put from a stand; a total track and field score computed by combining these 3 track and field events;[2] a total strength including scores from 28 different strength tests of both the Martin and intercollegiate type;[3] a shoulder girdle strength which included the pectorals, both anterior and posterior deltoids, latissimus, trapezius, and forearm flexors and extensors; and an arm strength combination of the right and left grip with the push and pull strengths. The reliabilities of the tests were found to be sufficiently high to justify their use.[4]

A factor analysis using Thurstone's method[5] was carried out with eight of the variables. The intercorrelations are shown in Table I.

Dash and broad jump are both negative to weight and normal weight, yet the several variables involving strength are positive to weight in all cases.

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[1] This normal weight was computed according to the formula for college women in C. H. McCloy, *Appraising Physical Status; Methods and Norms* (Iowa City, Iowa: University of Iowa, 1938).

[2] Each of the three track and field events was T-scored. This accounts for the fact that the correlations of the dash with the other variables are positive rather than negative as would have been the case if the correlations had been in units of time. The three T-scores were added to obtain the total track and field score.

[3] Aileen Carpenter, "A Critical Study of the Factors Determining Effective Strength Tests for Women," Research Quarterly, 4:4 (Dec. 1938).

[4] *Ibid.*

[5] L. L. Thurstone, *The Vectors of Mind* (Chicago: University of Chicago Press, 1935).

TABLE I
INTERCORRELATIONS OF EIGHT VARIABLES *

	Weight	Normal Weight	Dash	Broad Jump	Shot-put	Shoulder Strength	Strength Total
Normal weight ..	.8737						
Dash	—.0734	—.1129					
Broad jump	—.1524	—.0673	.5957				
Shot-put	.4238	.4439	.2675	.3108			
Shldr. strgth.	.5099	.4026	.2079	.2748	.4773		
Tot. strength .	.5854	.5219	.2407	.2061	.5649	.7874	
Grips, push and pull	.3957	.3338	.1115	.1910	.4261	.4497	.5391

*All correlations and factor loadings are given to four decimals. They are of course not "significant" to four decimals. In a factor analysis, however, early rounding off frequently results in finding it difficult to check results with assurance. Since some readers may wish to check the computations, the results are given in this form.

The factor analysis, after rotation by the two-factor-at-a-time[6] method resulted in the loadings given in Table II.

TABLE II
ROTATED FACTOR LOADINGS * OF EIGHT VARIABLES

	I	II	III	*h*
Weight	.6279	—.0248	.7034	.9432
Normal weight	.5458	.0981	.7055	.8973
Dash	.2332	.6068	—.2900	.7118
Broad jump	.2688	.6163	—.3689	.7670
Shot-put	.6249	.3166	.0622	.7033
Shoulder strength	.8460	—.0429	—.0132	.8472
Total strength	.8991	—.0190	.0516	.9008
Grips, push, pull	.6255	.0568	—.0507	.6302

* The fourth and subsequent factors were found not to be significant, and hence omitted here.

These "factor loadings" may be interpreted as zero-order correlations with their respective factors. The different *factors* are uncorrelated with each other.

Factor I is most heavily weighted with the strengths in the three strength events and the strength variables have no significant loadings in either of the other factors. We are therefore safe in identifying this factor as ***strength***. Factor II has significant loadings only in track and field events and not with either weight or strength, hence this may be safely identified as *velocity*, or speed of movement. The third factor is more difficult of identification. It is most heavily loaded with the two weight variables but these are also heavily loaded in the strength factor. We therefore propose the theory that body weight may be divided into two components, that part of weight which is muscular tissue and which appears in Factor I as strength, and the part of weight which is not represented by contractile tissue but which is purely a load on muscular weight. We shall call the first "live weight" and the second "dead weight" and propose the identification of the third factor as ***dead weight***. This

[6] J. P. Guilford, *Psychometric Methods* (New York: McGraw-Hill, 1936).

identification is strengthened by examination of the other factor loadings for this factor. Dead weight would be a handicap to the dash and the broad jump, as it would be simply surplus baggage. It would be an advantage in the shot-put—or at least no disadvantage—because of the increased resistance to the reaction from the shot-put effort.

Using these factor loadings, the dead weight factor when correlated with the multiple regression combination of the actual weight and total strength resulted in a multiple correlation of .8325. The following formula for the prediction of dead weight from total strength and weight was then worked out:

$$\text{Dead weight} = 1.6079 \text{ weight} - .0247 \text{ total strength} + 9.29$$

To obtain these multiple regressions to predict a factor, since the factor has no mean and no standard deviation, 50 is used for the mean and 10 for the standard deviation. This results in a score which is in terms of a T-score.

Total strength and actual weight combined gave a multiple correlation of .9076 with the strength factor. From these the following formula resulted:

$$\text{Strength factor} = .0364 \text{ total strength} + .2408 \text{ weight} - 34.85$$

For the prediction of the velocity factor, two combinations were tried. Broad jump, total strength, dash and shot combined gave a multiple correlation of .7469 with the velocity factor, while broad jump, total strength, and shot combined gave a multiple correlation of .7190. Considering this and the fact that the dash and the broad jump correlate almost equally with the factor—the broad jump slightly higher—it was decided to use the latter in the formula for the prediction of the velocity factor, even though the multiple correlation is slightly lower. This also permitted us to administer the test indoors, using the indoor shot. The velocity factor may be predicted from the following formula:

$$\text{Velocity factor} = .5795 \text{ broad jump} + .6777 \text{ shot-put} - .0203 \text{ total strength} - 23.22$$

These three values were then computed by the above formulas for each of the 100 subjects. Three more variables were computed for the study, strength factor divided by weight factor (SF/WF), strength factor divided by weight T-score (SF/WTS), and weight factor divided by weight T-score (WF/WTS). These six new variables were then intercorrelated with each other as well as with the shot, broad jump, dash, actual weight, shoulder girdle strength, total strength, and the track and field combined score. Table III gives the intercorrelations.

It is interesting to note that the weight factor is negative to all but the strength factor, shot-put, weight, shoulder girdle strength, and total strength. It is significantly positively correlated only to weight. The strength factor, as would be expected, is closely related to total and

TABLE III
INTERCORRELATIONS OF THIRTEEN VARIABLES

	WF	SF	VF	SF/WF	SF/WTS	WF/WTS
WF						
SF	.2366					
VF	.1161	—.0384				
SF/WF	—.5452	.6477	.1124			
SF/WTS	—.8676	.2921	.1056	.8283		
WF/WTS	—.0465	—.8207	—.0808	—.1590	—.2546	
Shot	.1459	.5424	.6232	.3721	.1696	—.5047
Dash	—.3320	.1731	.4598	.4158	.3644	—.2281
BJ	—.3278	.1176	.7679	.3586	.3335	—.2374
Wgt.	.7951	.6366	—.0826	—.0859	—.3978	—.5384
SS	.0914	.7751	—.0126	.5368	.3210	—.6681
TS	.0763	.9679	.0187	.6913	.4176	—.8365
T&F	—.2314	.3691	.7846	.4893	.3643	—.4288

	Shot	Dash	BJ	Wgt.	SS	TS
WF						
SF						
VF						
SF/WF						
SF/WTS						
WF/WTS						
Shot						
Dash	.2675					
BJ	.3108	.5975				
Wgt.	.4238	—.0734	—.1524			
SS	.4773	.2079	.2748	.5099		
TS	.5649	.2407	.2061	.5854	.7842	
T&F	.6669	.7956	.8268	.0617	.3317	.3959

shoulder girdle strengths, weight, shot-put, and the strength factor divided by weight factor. It is highly negative to weight factor divided by weight T-score. The velocity factor shows a high relation to shot-put,

TABLE IV
ROTATED FACTOR LOADINGS OF THIRTEEN VARIABLES

	I	II	III	h
Weight factor	.1704	—.0229	.9582	.9734
Strength factor	1.0019	—.0087	.0056	1.0019*
Velocity factor	—.0289	.8927	—.0254	.8935
SF/WF	.5674	.1280	—.6440	.8678
SF/WTS	.3188	.0344	—.9140	.9686
WF/WTS	—.7837	—.1503	.0484	.7994
Shot-put	.5682	.5484	.1181	.7984
Dash	.1633	.6364	—.3710	.7545
Broad jump	.1004	.7796	—.3706	.8690
Weight	.6416	.0284	.6952	.9465
Shoulder strength	.8309	.0811	—.0577	.8368
Total strength	1.0035	.0411	—.1105	1.0104
Track and field	.3144	.9187	—.2512	1.0029

* Ordinarily communalities should not exceed 1.0000. The three that we have in this column are undoubtedly the result of the values assumed by the Thurstone method in the diagonals. Since experience has shown that re-doing such an analysis with somewhat lower diagonal values does not significantly alter the factor loadings, this has not been done here.

broad jump, and the track and field combination, is fairly high with dash, and is almost zero with the strengths and weights.

A rotated factor analysis of these thirteen variables resulted in the loadings[7] in Table IV.

When we examine the factor loadings in Table IV a number of things stand out. First, the dead weight factor, the strength factor, and the velocity factor are measured to a very high degree of validity and in almost pure form, as is evidenced by the high factor loading in its own column and the negligible factor loadings in other columns. The track and field events would indicate that the most important contributions are made by velocity and strength respectively, with the latter showing significantly in the shot-put. As would be expected, the shot-put has a slight positive correlation with the dead weight factor and the dash and broad jump have relatively low but significant negative correlations with the dead weight factor. Weight is relatively highly correlated with both strength and dead weight factors while the strengths, as would be expected, are significantly correlated only with the strength factor.

Let us next consider the three index correlations,[8] strength factor/weight factor (SF/WF), strength factor/weight T-score (SF/WTS), and weight factor/weight T-score (WF/WTS).

1. In the first index, strength factor/weight factor, as would be expected from such an index correlation, the numerator (strength factor) will insure a positive correlation with the strength factor while the denominator, (weight factor) will insure a negative correlation with the weight factor itself.

2. The same is true of strength factor/weight T-score. These first two index numbers may be thought of somewhat in the light of "factor physical fitness indices" in the sense that as in the Physical Fitness Index (P.F.I.) strength is in the numerator while a function of weight is in the denominator, so in these indices we have the *factor* of strength in the numerator and a function of weight in the denominator. By these factor loadings we see the important part played in such a P.F.I. by dead weight.

3. The third index, weight factor/weight T-score, rather surprisingly has no significant loading with the weight factor. It has a very negative loading with the strength factor. The significance of this seems to be that the greater the dead weight is in proportion to total weight, the less will be the strength, while in the index (strength factor/weight

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[7] The factor loadings of the variables common to Tables II and IV vary slightly. This is because of the fact that in all methods of factor analysis certain assumed values must be placed in the diagonals of the correlation matrix. (See Thurstone, L.L., *Vectors of Mind*, Chapter III) The smaller the number of variables, the larger this error may be. It is therefore highly probable that the values in Table IV are the more accurate.

[8] G. W. Yule, and M. G. Kendall, *Introduction to the Theory of Statistics* (London: C. Griffen and Co., Ltd., 1937) p. 300.

T-score) the greater the strength factor in proportion to weight, the less will be the dead weight factor.

SUMMARY AND CONCLUSIONS

The data used in this study were secured from the measurements taken on one hundred college girls. An analysis was made of the variables of strength, power, and weight and from these were predicted (from multiple regression equations) these three factors, strength factor, velocity factor, and dead weight factor, which were later computed for each individual together with three more indices, the whole then being re-analyzed.

The significant contributions are that three uncorrelated factors or components of motor activities of the power variety have been isolated in relatively pure form and to a degree of validity which is undoubtedly as high as the reliability of the batteries of variables from which they were computed. The usefulness of such a set of factors so computed lies first in the fact that for research purposes each of these qualities may be computed for any given woman of the college age group. Second, if such computed values are placed in a battery of tests being factored, these three factors are immediately identifiable, thus greatly simplifying this particular problem. Third, it seems to us that the availability of these measures opens up numerous problems in the fields of tests and measurements, of the analyzing of motor abilities and of anthropometry, which have thus far been most resistant to a research attack. We should suggest that numerous similar studies be conducted on other age groups in order that standards may be made available for each.

It should be remembered that these factors are in terms of *T-scores for the experimental group used;* hence these formulas should be used with caution on any other group. If upon using these three factors with any other group of girls or women, a tabulation of the results is found to have a mean of approximately 50 and a standard deviation of approximately 10, the experimenter can probably proceed with confidence.

Achievement Examinations for Elementary and Intermediate Tennis Classes

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THE Central Association of Physical Education for College Women, through its Research Committee, has set for itself a long-term project aimed at the improvement of the written examination for college physical education classes. The first report of this work was in the field of swimming.[2] The purpose of this report is to present a similar test of knowledge in tennis. Some work was also done on tennis skill tests and a summary of that work is included.

The aim of the organization in developing these tests is to provide examinations that are superior to those which the individual teacher has time to construct, that will serve as an adequate measure of comprehension in the respective sports, and that will serve as a pattern for the construction of other test items and examinations. It is also hoped that this work will encourage the practice of expecting increase in knowledge and understanding, as well as development of skills in college classes.

PROCEDURE

The procedure followed in this study was almost identical with that in the swimming study.[2] The test items were based on material considered important by members of the committee, all of whom teach tennis. The experimental form of the elementary examination consisted of 30 multiple choice and 47 true-false items. The intermediate consisted of 31 and 41 items, respectively, of the two types. Reports were returned from 19 schools providing 818 cases for the elementary and 296 for the intermediate examinations.

The instructor was also asked to rate each player's ability, according to a descriptive scale which was sent to her. She was also asked to administer skill tests if she had time and facilities. The tests consisted of forehand, backhand, and service tests, very similar to

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[1] Other members of the committee working on this study were Leonore Alway, Aileen Carpenter, Louise Kuhl.

[2] M. Gladys Scott, "Achievement Examinations for Elementary and Intermediate Swimming Classes," Res. Quart., 11:2 (May 1940) 100.

those suggested by Driver,[3] and the Dyer backboard test.[4] The returns showed all four tests completed for 128 elementary students and 63 intermediate ones, while an additional 230 beginning and 104 intermediate students took all tests except the Dyer.

Additional data collected at the same time in classes at the University of Nebraska made possible further analysis. Two judges rated each player on form while she took the drive and service tests. One judge could see only the performer, the other could also see where the ball went. Scores were kept on all balls as to where they fell and whether they went over or under the rope. The Dyer test was given near the beginning of the course and again several weeks later near the end of the course. The Hewitt [5] knowledge test was given as well as the experimental battery of this study. The cases varied from about 120 to 150.

ANALYSIS OF DATA

The items to be retained in the written tests were selected on the basis of the difficulty rating (percentage passing the item) and the index of discrimination ($\text{mean}_{\text{rights}} - \text{mean}_{\text{wrongs}}$). The easiest items were omitted, those with a difficulty rating of more than 95 in the elementary form and above 96 in the intermediate one. The minimum index of discrimination for selecting valid items was 5.0. This left in the elementary examination 25 multiple choice and 41 true-false items, and in the intermediate examination 21 multiple choice and 30 true-false items. The data on each item appear with the question. In the multiple choice items, choices that were never selected were eliminated.

The reliability of the final batteries was computed by correlating odd and even items and correcting to actual length by the Spearman-Brown formula. The reliability coefficient of the elementary examination was .87 on a sample of 404 cases, and that of the intermediate was .78 on the entire 296 papers.

The papers were scored again on the items retained and the following grading scale is suggested for those who wish to use the examination for grading or for comparison with the group represented here.

	Elementary			*Intermediate*	
A	58–64	7 per cent	A	44–50	6 per cent
B	51–57	21 per cent	B	36–43	23 per cent
C	36–50	44 per cent	C	23–35	42 per cent
D	22–35	21 per cent	D	12–22	23 per cent
Fd	−2–21	7 per cent	Fd	6–11	6 per cent

The coefficients obtained by intercorrelations of the various items are all low, with the exception of each of the stroking tests with their

[3] Helen Irene Driver, *Tennis for Teachers* (Philadelphia: W. B. Saunders Company, 1936) 162.

[4] Joanna T. Dyer, "Revision of the Backboard Test of Tennis Ability," RES. QUART., 9:1 (March 1938) 25.

[5] Jack E. Hewitt, "Comprehensive Tennis Knowledge Test," RES. QUART., 8:3 (October 1937) 74.

sum. These are spuriously high as would be expected from such a combination (see Table I).

TABLE I

INTERCORRELATIONS OF TEST ITEMS*

	Knowledge	Forehand	Backhand	Serve	Combination	Dyer	Rating	Seasons
Knowledge		.31	.40	.32	.40	.18	.21	.09
Forehand	.37		.58	.46	.82	.36	.22	.35
Backhand	.37	.42		.35	.73	.43	.22	.19
Serve	.36	.49	.38		.79	.25	.19	.48
Combination†	.44	.80	.67	.82		.43	.26	.21
Dyer	.38	—.03	.33	.09	.15		.23	.44
Rating	.35	.42	.38	.29	.42	.38		.41
Seasons‡	.29	.40	.29	.31	.09	.41	.26	

* Elementary group represented in lower left section of table.
Intermediate group represented in upper right section of table.
† Combination—sum of forehand, backhand, and serve.
‡ Number of previous seasons of playing.

The findings on the Nebraska data are summarized in Table II. The agreement between the judges' ratings is about that commonly found, but may be partially explained by the fact that one judge was doubtless influenced by placement of the ball. When judging specific skills, i.e., drives and serves, the agreement is somewhat higher than when judging general ability. This would verify the advice which is commonly given, namely, that all subjective ratings be made on well-defined and commonly understood points.

TABLE II

CORRELATIONS ON NEBRASKA DATA

		Forehand	Backhand	Serve
Ratings of two judges on ability in the game	.65			
Ratings of two judges on strokes during testing		.77	.77	.71
Seasons played and sum of judges ratings		.43	.51	.43
Score on balls going under rope and score on balls both over or under		.80	.85	.92
Score on balls going under rope and sum of judges ratings		.39	.66	.41
Score on balls both over and under rope and sum of judges rating		.63	.76	.46
Sum of the Dyer in October and November*	.60			
Sum of the Dyer in October and Hewitt in October	.31			
Sum of the Dyer in November and Hewitt in November	.29			
Elementary experimental battery and Hewitt	.26			
Intermediate experimental battery and Hewitt	.38			
Seasons played and Hewitt in November	.31			
Seasons played and experimental battery	.34			

* Tests were given early in October at beginning of season and late in November at end of season.

The difference between the experimental battery and the Hewitt test is explained by study of the content of the two examinations. The latter contains some items concerning historical points, tournaments and tennis players. The other items seem to be in agreement with that found in the rest of the study, indicating little relationship between test scores and ratings, or between ability on skill tests and knowledge tests.

Coefficients of .80, .85, and .92 on the respective stroke tests with and without the use of the rope might indicate a possible simplification of the testing setup. It must be remembered, however, that the test was taken with the rope there and with instructions to play the balls under it. It is very possible that different results might be obtained without the rope. Further investigation is necessary to determine this point.

Assuming that the Dyer test is a valid and reliable measure of playing ability, there is considerable variation in the amount of learning during the term by different members of the class.

Correlations between seasons played and all measures of skill and knowledge are very low. Therefore, it appears evident that a classification of students in classes on the basis of previous experience is entirely inadequate.

CONCLUSIONS

The following conclusions appear to be justified from these data:

1. The written tests which were constructed here are satisfactory for measuring tennis knowledge.

2. The knowledge of the student about tennis is not directly related to the degree of skill.

3. These examinations do not test for the same content as the Hewitt tests. The teacher should select the examination or the test items which most adequately cover the content of her own course.

4. Students advance at different rates in both skill and knowledge. Objective measures of both factors would seem desirable, therefore, to measure achievement and to determine classification for further instruction.

5. More work is desirable on several of the points raised in this study.

ELEMENTARY TENNIS EXAMINATION

Part I. Read each question carefully. Select the *one* item which best answers the question. Put the number of that item selected in the space in front of the question. All questions are in terms of a right handed player.

Discrimination	Difficulty	Answer	
10.1	88	2	1. In what direction should a player face in order to make a good forehand stroke? (1) Squarely toward the net, (2) squarely toward right alley, (3) squarely toward left alley.
9.6	60	2	2. What happens when the server serves before the opponent is ready? (1) A fault is called, (2) a let is called, (3) a point is awarded to server, (4) a point is awarded to receiver.

6.8	88	*4*	3. A person, not engaged in the game, interferes with the play by walking on the court during the play. What is the decision? (1) Point stands as played, (2) the player who is interfered with is awarded the point, (3) a fault is called, (4) the point is replayed.
7.6	89	*3*	4. If a ball rolls onto the neighboring court where play is going on, how should the ball be recovered? (1) Call to player on the court to return the ball, (2) run onto the court and get it out of the way quickly, (3) wait until point is finished on neighboring court, (4) it is a lost ball, do not recover it at all.
6.1	27	*1*	5. If a receiver is unable to determine whether a ball is good or just outside, what should she do? (1) Call ball good, (2) ask server to play point over, (3) call a fault, (4) ask the server to make the decision.
10.6	75	*3*	6. When is a set completed? (1) At the end of each 6 games that are played, (2) when either player has won 6 games more than opponent, (3) when either player has won 6 games, opponent not more than 4, (4) when either player has won 6 games, opponent any number of games.
5.0	43	*1*	7. What should be the player's position in the baseline game? (1) Approximately 3 feet behind the baseline, (2) halfway between the baseline and net, (3) between the baseline and the service line, (4) right on the baseline.
20.3	94	*3*	8. What is the score of a player who has won 2 points? (1) Love, (2) 40, (3) 30, (4) 15, (5) deuce, (6) 20.
15.1	83	*4*	9. What is the score when server wins the next point after deuce? (1) Deuce-one, (2) love, (3) game for server, (4) advantage server.
9.1	72	*4*	10. What is the difference in rules for women and men? (1) Size of court, (2) number of points in a game, (3) number of games in a set, (4) number of sets in a match, (5) number of balls allowed in service.
10.8	81	*3*	11. Who wins the set when opponents have each won 5 games? (1) First side to win a game, (2) first side to reach a score of 7 games regardless of opponent's score, (3) first side to win 2 games after opponents have had an equal number of games, (4) first side to win 3 games in succession.
6.7	88	*2*	12. What is the position in which a player waits for opponent to return a ball? (1) Weight well back on heels, knees straight, (2) weight forward on balls of feet, feet slightly apart, knees bent, (3) feet close together, knees straight, (4) feet wide apart, body turned for a forehand drive.
8.8	62	*1*	13. When is a game finished? (1) One side has won 4 points and opponents have not more than 2 points, (2) one side has won 4 points, opponents have 3, (3) a total of 4 points have been played, (4) either side wins 6 points.
12.1	62	*5*	14. When is the score called deuce? (1) Any time each team has an equal number of points, (2) one team has no points, (3) one team has 2 points, (4) each team has 2 points, (5) each team has 3 points.
8.8	66	*4*	15. What happens if a served ball touches the top of the net in going over but is otherwise good? (1) Considered a good service and ball continues in play, (2) a fault is called, (3) receiver wins the point, (4) ball is replayed.

6.8	80	2	16.	What constitutes a foot fault? (1) Server steps over the baseline just before served ball crosses the net, (2) server steps over the baseline before her racket strikes the ball, (3) server's feet are not on the baseline when serving.
10.5	95	5	17.	When the server has 2 points and the opponent none, what is the score? (1) 30-deuce, (2) 30-15, (3) 40-love, (4) 15-love, (5) 30-love, (6) 20-0.
11.2	78	3	18.	When is the score called "advantage in"? (1) Server has one more point than opponent, (2) receiver has one more point than opponent, (3) server wins a point after being tied with 3 points each, (4) receiver wins a point after being tied with 3 points each, (5) server wins one more game than opponent.
5.8	53	3	19.	What is the usual position in waiting to receive the service of a good player? (1) On the service line, (2) between the service line and baseline, (3) near the baseline, (4) outside the alley a step or two nearer the net than the baseline.
9.6	22	5	20.	Where is the server permitted to stand while serving in singles? (1) Any place behind the baseline, (2) on the baseline, (3) in front of the baseline, (4) behind the alley, (5) alternately behind the right or left half of the baseline.
12.2	59	2	21.	When do players change sides of court? (1) After every game, (2) after every odd numbered game in set, (3) after every even numbered game in set, (4) only after end of each set.
7.7	90	2	22.	When the server has one point and the opponent has 3, what is the score? (1) Love-30, (2) 15-40, (3) 5-30, (4) 5-40, (5) 15-45.
6.7	89	2	23.	Where will the ball go if the racket face is toward the net but tilted slightly upward when hitting the ball? (1) into the net, (2) in a high arc across the net, (3) straight up, (4) slide up across racket and on behind player.
10.1	37	4	24.	What height should the ball bounce for the easiest and best forehand drive? (1) Just above head, (2) shoulder high, (3) waist high or slightly above, (4) between knee and hip, (5) between knee and ankle.
8.0	66	2	25.	When is a second ball allowed on a service? (1) When receiver fails to return the first one which lands in the service court, (2) when the server commits a foot fault, (3) when the server fails to call the score before playing.

Part II—Read each question carefully. If statement is entirely true, encircle the *T*, if wholly or partially false, encircle the *F*.* *Do not guess,* but answer all for which you have any definite basis for a decision.

10.2	93	T	1.	In a singles game the alleys are not used.
7.3	86	T	2.	The server always keeps the score in informal matches.
7.2	93	F	3.	The server should play the first ball easily and rely upon the second one to be good.
10.7	71	T	4.	In doubles the receiver always receives in the same court throughout the entire game.
5.3	80	T	5.	In driving, at the time the racket contacts the ball, the wrist should be absolutely firm.
8.5	90	F	6.	A player should never hit a ball that is below knee level.
6.7	63	F	7.	A beginner should, when possible, move to use her forehand drive instead of her backhand which is usually a weaker stroke.

* In preparing examination papers, the letters *T* and *F* should precede the number of the question.

5.4	76	T	8. During the execution of the forehand drive the weight should be transferred from the right foot to the left foot.
12.1	90	F	9. In the service the ball should be hit before it reaches the highest point in the toss.
7.9	68	F	10. During the service the receiver must stand inside the court.
8.5	65	F	11. To rally means to hit the ball before it bounces.
10.0	73	T	12. A ball falling on the outer edge of a line bounding the proper court is considered good.
10.9	55	T	13. There is no limit to the number of "let" balls that are allowed in succession.
11.5	75	F	14. A player may not run outside the boundary lines in returning a ball.
6.5	78	F	15. In preparing for a backhand drive, the weight should be well back on the heels so as not to be off balance.
5.1	68	F	16. In singles it is permissible for the server to stand behind the baseline back of the alley.
5.4	91	T	17. The grip on the racket should be tight at the time of the impact with the ball.
5.8	61	F	18. It is best to look up and watch your opponent just before hitting the ball in order to place the ball to her disadvantage.
13.2	95	F	19. In singles, whenever a player wins two points in succession, she wins the game.
7.2	64	F	20. The service court for doubles is larger than in singles.
9.2	91	F	21. The player making a forehand drive should be facing the net.
6.7	79	T	22. If a player steps on the baseline during the second trial in the serve, the opponent wins the point due to a foot fault.
11.1	90	T	23. One player serves an entire game.
9.3	72	T	24. The ball must bounce once on the service and may or may not be allowed to bounce on a return before being struck.
12.3	90	F	25. A game in which one player wins all the points is called a "deuce" game.
10.8	84	F	26. In playing doubles the members of the receiving side each change sides of their court on every point.
9.2	68	F	27. The best place to wait for a service is about on the service line.
7.6	90	F	28. The receiver should catch a ball which she sees is going outside the court, and declare it out.
11.0	60	F	29. In a doubles game a ball that is served into an alley is a good ball.
11.5	84	F	30. In case of a "let" ball on the service, the server loses the point.
14.5	94	F	31. If the first service is not good, the receiver should return the ball before the next service is made.
7.8	93	F	32. If the server wins the game he also wins the right to serve during the next game.
12.4	88	F	33. During the service the server must stand within the court.
13.2	81	F	34. After a deuce score the two players alternate serving until the game is finished.
7.9	52	T	35. It is a foot fault if the server jumps into the air in reaching to hit the ball she has tossed.
8.4	85	T	36. The server should call the score each time a point is finished.
5.7	86	T	37. White is the most universally accepted color for tennis costumes.
6.1	78	T	38. Tennis balls lose their power of rebound when not in use for a period of time.
10.8	52	F	39. A served ball which touches top of net and falls over into proper service court is called a "net" ball.

11.9	71	F	40. A returned ball which touches the top of net as it goes over and falls inside court is not considered a good return.
6.8	87	T	41. The receiver is responsible for deciding whether or not the service is good when there are no officials on the game.

INTERMEDIATE TENNIS EXAMINATION

Part I—Read each question carefully. Select the *one* item which best answers the question. Put the number of that item selected in the space in front of the question. All questions are in terms of a right handed player.

Discrimination	Difficulty	Answer	
8.4	71	3	1. What choice is given the winner of the toss? (1) Choice of sides of court, (2) choice of serving or receiving, (3) choice of either serving or receiving, or court, (4) choice of number of games to be played in each set.
8.6	66	4	2. If a spectator interferes with the play what is the decision? (1) Play continues and point stands as played, (2) the player who is interfered with is awarded the point, (3) a fault is called, (4) a "let" is called.
7.5	87	3	3. What is the difference in rules for women and men? (1) Size of court, (2) number of games in a set, (3) number of sets in a match.
6.96	64	2	4. From which side of court should service be made on the play after score has reached 40-love? (1) Right side, (2) left side, (3) depends upon side from which game started, (4) depends upon side from which last service was made.
13.1	88	2	5. How many sets in an official match for women? (1) One, (2) 2 out of 3, (3) 3 out of 5, (4) any number the tournament management decides upon.
8.5	48	2	6. How many sets in an official match for mixed doubles? (1) One, (2) 2 out of 3, (3) 3 out of 5, (4) any number the tournament management decides upon, (5) any number the players agree upon.
9.2	71	3	7. Which of the following strokes does the service resemble most? (1) Drive, (2) lob, (3) smash, (4) volley.
6.5	50	2	8. What should be the height of the center of the net? (1) 2½ feet, (2) 3 feet, (3) 3½ feet, (4) 4 feet, (5) the same height as that of the racket placed on end.
8.5	83	3	9. What does it mean if a player receives a "bye" in a tournament? (1) She is placed against an easy opponent, (2) she is eliminated from the tournament, (3) she advances to the next round of the tournament, (4) she is privileged to select her first opponent.
13.4	55	1	10. If a partner serves out of turn, and the mistake is discovered after two points are finished and one fault served, what is the correct thing to do? (1) Let the correct player start in with game at that count, (2) start game over again, (3) award game to opponents, (4) award the two points to the opponent.
9.2	55	3	11. A ball hits A's racket which is out of her hands but still in the air. The ball rebounds over the net. What is the correct decision? (1) Play point over again, (2) A's point, (3) opponent's point.
8.9	47	4	12. When may players rest during match play? (1) At any time, (2) only when match is finished, (3) at end of first set, (4) at end of second set, (5) decided by the tournament management.

9.4	36	*3*	13. If players wish to rest during a match, what is the maximum time limit? (1) 3 minutes, (2) 5 minutes, (3) 10 minutes, (4) 15 minutes, (5) no limit.
10.0	79	*2*	14. When do players change sides of court? (1) After every game, (2) after every odd-numbered game in set, (3) after every even-numbered game in set, (4) only after end of each set.
7.78	59	*4*	15. What is the effect of back spin on the ball? (1) Makes it travel faster, (2) makes it drop very rapidly, (3) makes it harder to see coming, (4) makes the bounce lower.
5.3	70	*4*	16. How is top spin put on a forehand drive? (1) Hitting down on top of the ball, (2) hitting underneath the ball, (3) sending ball in high arc, (4) drawing racket up over ball as it is struck.
11.3	67	*1*	17. Where should the serve be placed in service court? (1) In rear corners, (2) in front corners, (3) in center of court, (4) just over the net.
5.98	88	*3*	18. What is the best waiting position during a rally in singles? (1) Spot from which last stroke was played, (2) near the center of court, (3) near the center of baseline, (4) inside service area.
16.9	31	*3*	19. What is the correct net position? (1) one foot from net, (2) 3 to 5 feet from net, (3) 5 to 8 feet from net, (4) 10 to 12 feet from net.
6.7	40	*4*	20. Which play is more effective in singles? (1) Repeated driving, (2) volleying, (3) lobbing, (4) change of pace, (5) fast serving.
5.2	39	*3*	21. What is the score when each team has five games? (1) deuce, (2) 5-all, (3) games-all, (4) tie, (5) advantage-all.

Part II. Read each question carefully. If statement is entirely true, encircle the *T*, if wholly or partially false, encircle the *F*.* *Do not guess,* but answer all for which you have any definite basis for a decision.

7.3	88	T	1. If a server tosses the ball and makes no attempt to hit it, it does not count as a fault.
9.8	92	T	2. During the rally in a doubles game, if one player attempts to return a ball and fails to touch the ball his partner may return it.
7.49	56	F	3. In doubles, the first server is required to receive in the right court after his term of service.
13.3	84	F	4. A lob is a swift ball aimed to skim the net.
5.9	77	T	5. If a player's racket touches the net when finishing a volley, the point goes to the opponent.
11.9	93	T	6. A match for women consists of winning 2 sets out of 3.
6.7	84	F	7. Score is love-30. The server should serve the next point from the left hand service court.
6.1	58	T	8. It is legal to drop the ball and serve it with an underhand stroke if it does not touch the ground before being hit.
8.5	80	T	9. The lob may be used either to gain time or to get the ball over the head of the opponent at the net.
9.3	80	F	10. On a lob the ball is always hit before it touches the ground.
6.3	82	F	11. A player may not use both hands on the racket.
7.2	60	T	12. A player loses the point if the ball is touched by her racket while it is not in her hands.

* In preparing examination papers, the letters *T* and *F* should precede the number of the question.

9.5	88	T	13. A player loses the point if she volleys the ball before it has crossed the net to her side.
7.6	95	F	14. The server in doubles should not expect to play the ball again in that rally except when her partner may miss a return.
6.2	69	F	15. A player near the net volleys the ball and after striking it her racket passes above the net. The ball is not returned to her side. She loses the point because the racket was across the net.
7.7	80	F	16. A player moving into position for a drive should get as nearly as possible in the direct line of flight of the ball.
7.57	66	T	17. A player very seldom uses the volley except when playing the net position.
8.4	86	T	18. A ball which has a high arc on a serve will ordinarily bounce higher than one traveling in a straight course.
6.65	73	F	19. The volley is used more in singles than in doubles.
6.9	52	F	20. The aim in singles should be to keep returning the ball to the opponent till she plays it out of court.
7.49	64	F	21. More points are won in doubles with long fast drives than with any other stroke.
9.6	50	T	22. The team at the net has the advantage in doubles.
10.1	82	T	23. The smash is more effective from the front half of the court than the rear half.
6.2	77	T	24. The lob is often used in doubles to drive opponents from the net.
9.1	53	T	25. Good doubles players play together in the backfield or advance to the net together.
5.15	85	F	26. The toss to start a match is made by flipping a coin.
5.3	79	F	27. In playing a match, players should not talk to each other between games.
5.65	83	F	28. If watching a tennis match one should applaud a good service immediately as encouragement to the player.
6.8	55	F	29. A volley may be used only if the ball is above the level of the top of net when it is played.
10.8	67	F	30. There should be as much back swing in the volley as there is in the backhand drive.

The Best Method of Manual Artificial Respiration

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WHAT is the best method of manual artificial respiration? An American reader naturally expects that the only answer to this question is the prone, or Schafer's method. Approximately fifteen million Americans have been taught this method, and fifteen million cannot be wrong!

Yet Silvester's method has an overwhelming bulk of scientific support, coming mostly from Holland and Germany. Eysselsteijn in his classic work[1] * emphasized it as the only method to be used. Mijnlieff[2, 3, 4] and Bruns and Thiel[5, 6, 7] have presented an accumulated experimental evidence proving that Silvester's method is the best method of manual artificial respiration. This method is at present in general use in Holland.

Until 1934, Schafer's method was generally accepted in Denmark, and the use of Silvester's method on apparently drowned persons was even prohibited by the Danish Red Cross.[8] At present, the Nielsen method is considered the best in Denmark and has supplanted all other methods. Norway also is using the Nielsen method.

In France, Schafer's method is still widely used, but through the efforts of Dr. Héderer[9, 10] a combination of the Schafer and Nielsen methods (called the Schafer-Héderer method) has been introduced in the French Navy. Essentially the same method in a simpler form was independently suggested in this country by Drinker and Shaw.[11] The Silvester method also has its devotees in France.[12]

The Schafer method is the official method endorsed by the lifesaving societies in Germany, although the medical organizations prefer the Silvester system.

In England, where it originated, the Schafer method is still considered the best.

These few references show clearly that there is no universal agreement as to which method of artificial respiration is the best. To a person who has been taught only one method, with constant admonition that he is learning the *best* method, it may be shocking to discover that there are other methods claiming this same distinction.

The inquisitive-minded person may think it strange that this question has not yet been settled experimentally. It is true that many experi-

* Superior numbers refer to Bibliography at end of article.

ments have been made, but somehow or other either the results or the interpretation of the results has often been controversial.

Animal experiments, indispensable as they are, have given little help so far in deciding which method of artificial respiration is the best for man. The anatomical structure of most laboratory animals makes it impossible to reproduce exactly conditions typical for human beings. Monkeys would be better subjects, but probably due to the expense involved, very few experiments have been made on them.[3, 13]

Experimental work on human beings is obviously very limited, consisting mainly of the measurement of lung ventilation during artificial respiration. Bruns and Thiel, Liljestrand, and Cordier believe that these experiments are unreliable; hence, data obtained in this way should be accepted with a great deal of caution. As a matter of fact, Lundsgaard, in a personal letter to H. Nielsen,[15] expressed so much scepticism regarding this type of test that he said the question of the superiority of a method of artificial respiration should be solved on a theoretical basis. Experiments on human cadavers were subject to great difficulties due to the onset of rigor mortis and blood coagulation.

In the present article the discussion will be confined for the most part to these few methods: Schafer, Silvester, Nielsen, Howard, and Schafer-Drinker or Schafer-Héderer.*

WHAT ARE THE CHARACTERISTICS OF THE BEST METHOD?

The best method should, of course, be considered that method which is most successful in restoring the life of an apparently dead person. This means that such a method would meet the following conditions:

1. It should provide adequate lung ventilation and be the most effective in restoring spontaneous breathing.
2. It should provide the best assistance to blood circulation and to stimulation of heart action.
3. It should be harmless.
4. It should be easy to learn and to apply.

The last item is obviously of secondary importance. Ease of learning and application are definite advantages, although a more difficult but more effective method would be preferable to an easy but ineffective one.

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* The essentials of the various methods may be given as follows:

Silvester: Subject is put on his back. The operator kneels in front of subject's head, grasping the elbows. For inspiration, the subject's arms are brought over the head and clear to the ground. On expiration, the arms are brought to the chest and pressure applied. (There are several modifications of this method.)

Howard: Similar to the Schafer method, but the subject is lying on his back, and the operator therefore exerts pressure on the lower part of the front of the chest.

Nielsen: With subject in the prone position, the operator rests on one knee in front of head of subject. On expiration, pressure is brought to bear upon the shoulder blades. On inspiration, the operator lifts the body slightly by the shoulders.

Schafer–Drinker: Two men operate in this method. One performs a regular Schafer's manipulation; the other applies the Nielsen inspiratory elevation.

Schafer–Héderer: Very much like Schafer-Drinker, but the subject's hands are tied together and the inspiratory elevation is performed by lifting the subject's elbows.

LUNG VENTILATION

The technique of measuring lung ventilation is very simple. First, the respiratory passages of an experimental subject are connected with a suitable gasmeter, and then the various types of artificial respiration in question are performed.

In spite of the apparent simplicity of the technique, the results obtained by various investigators differ greatly and often are contradictory. A glance at Table I will illustrate this point.

TABLE I
LUNG VENTILATION (in liters)

Investigator	Schafer	Methods		Howard	Schafer-Héderer
		Silvester	Nielsen		
Héderer (in apnea)	0.10–0.15	0.20–0.25	0.12–0.15	0.10–0.13	0.25–0.28
Karpovich	0.67	0.65	0.76	0.40–0.80	0.80
Liljestrand	0.50	0.54			
Lindhard	.075		1.60		
Nielsen	0.77	0.73	1.40		
Ploman	0.50–0.60	1.20–2.00		1.00	
Schafer	1.00–1.20	0.70–0.90		0.52	
Waters, Bennet	0.68	0.59–1.06	0.68		
On Cadavers:					
Mijnlieff, Watermann	0.26–0.44	0.29–0.84	0.48–0.87	0.23–0.84	0.76
Bruns	0.50	2.00		0.50	

The difference in figures for the Nielsen method is especially striking. Tests in Denmark[14] gave as much as 1600 cc. per breath, whereas in America the same method gave but 760 cc.; in Canada the value obtained was only 60 per cent that of Schafer's.[15] Why did the Danes get such large figures? Since the veracity of the Danish reports is beyond question, the explanation of this should be sought in the behavior of the experimenters and of the subjects.

The Silvester method when used by its advocators also gave an ample lung ventilation, yet Burton-Opitz[16] found it so inefficient that he gave up experimenting with it. On the other hand, Henderson[17,18] could not obtain any lung ventilation by compression of the chest of a dead cat, although Burton-Opitz was able to do this effectively.

Yandell Henderson[17,18] has called attention to a peculiar phenomenon occurring in prolonged artificial respiration on subjects who voluntarily suspend breathing. When apnea develops, the amount of lung ventilation immediately decreases and cannot be increased either through a more frequent or a more energetic application of artificial respiration. Henderson explains this on the basis of the Hering-Breuer reflex. In this state, the tonicity of the respiratory muscles is increased on expiration and decreased on inspiration. This checks the respiratory excursion of the lungs, thus reducing the amount of ventilation. Hal-

dane and Priestly[19] have amply supported Henderson's observations, but doubted that this reflex could be evoked in an unconscious subject. A great deal of doubt has been cast by Mijnlieff[3] upon the appearance of this reflex even in conscious subjects. Neither he, nor other investigators mentioned by him (Ploman, Héderer, Liljestrand), have noticed the operation of this reflex in their conscious subjects. On some occasions, to be sure, Mijnlieff noticed some resistance on the part of the subjects to respiratory manipulation. However, this disappeared after a friendly talk and a suggestion to rest passively, and it was therefore concluded that this resistance was due to some psychic cause rather than to the Hering-Breuer reflex.

The writer has observed on many occasions a drop in the lung ventilation of subjects even after several experimental sessions, but it was impossible to be certain whether this was due to a reflex or to some other cause. However, since this happened with some of the men who were experimented upon for several successive days for an hour or two a day, it was concluded that the drop in ventilation was reflexive in nature.

From the standpoint of actual resuscitation, the Hering-Breuer reflex probably has no particular importance. Most of the reflexes of an apparently dead person are either abolished or considerably decreased, and the amount of lung ventilation will depend entirely upon the physical factors involved.

Experiments on cadavers have thus far been of little help. The low figures obtained by Bruns were due to a rigor mortis already setting in.

Now if we assume, for the sake of argument, that a certain method, say Nielsen's, gives the greatest lung ventilation, does it necessarily mean that it is the best method?

As Nielsen[20] himself stated, his method may lead to over-ventilation. This means a reduction of the amount of carbon dioxide in the lungs and then in the blood. The organism will thus be deprived of a powerful natural stimulant of the respiratory center, and a restoration of spontaneous respiration will be hindered. To obviate this, Nielsen recommended reducing ventilation to half by decreasing the pressure, and by minimizing the shoulder-lifting after fifteen minute intervals. Obviously, lung over-ventilation may be attained only if the respiratory passages are not blocked. In cases of drowning in which some parts of the lung are shut off, it probably would not happen. This last consideration practically destroys the basis for our previous speculations, and again leaves the problem wide open.

One additional factor may be introduced in the present discussion; that is the question of the amount of pressure developed in the lungs during various methods of respiration. Experiments carried on in my laboratory at Springfield College revealed great fluctuations in the pressure, depending on the type of subject and on the peculiarities of

the operator's technique. Although all the operators were trained men (most of them with lifesaving certificates) and although they executed the movements in a uniform way, there were noticeable differences. With Schafer's method the intra-pulmonic pressure varied from 4 to 20 mm. of mercury, and in Nielsen's method, it ranged between 12.5 and 27 mm. of mercury. There was more uniformity with the same operator and the same subject. A slightly greater pressure obtained with the Schafer-Drinker method (12.4 to 48 mm. of mercury) makes it somewhat more effective.

DAMAGE TO THE LUNGS

According to observations made by Leers and Horoszkiewicz, by Balan,[21] by Leclercq, Muller, and Marchand,[22] by Mijnlieff and Watermann,[3] in drowning alveoli may rupture; this may mean that excessive pressure will be definitely harmful. In this connection a certain modification of Schafer's method should be mentioned here. It was devised by Benedict[23] and is called the Alabama Power Company method. It differs from Schafer's method in one essential; that is, that when the pressure is brought to bear on the victim's back, the life-saver thrusts his legs backward so that his weight is supported by the hands and feet. With this method it is possible to develop twice as much pressure as with Schafer's method, but it can hardly be considered an advantage, since the danger to the lungs and the other organs becomes greater. Although in drowning a greater pressure may be more effective in opening the air passages, yet the compression of air trapped in the lungs may cause a rupture of lung tissue, rather than clearing up the passages.

Summing up, we are compelled to admit that nothing definite is known regarding the relationship between lung ventilation obtained with the various methods of artificial respiration and comparative success in actual cases of apparent death. It appears very often that "in the race for c.c. the drowned himself is completely forgotten."[3] Therefore, the methods may be considered as equally effective until more convincing data show the difference. Since the only logical experimental method is to drown a large number of monkeys under identical conditions, and then apply various methods of respiration, there is little likelihood that the data will be obtained in the near future. According to the amount of ventilation possible, the discussed methods may be arranged in the following order (first method highest): Schafer-Héderer (Schafer-Drinker), Nielsen, Schafer, Silvester, and Howard.

STIMULATION OF THE HEART AND ASSISTANCE TO BLOOD CIRCULATION THROUGH ARTIFICIAL RESPIRATION

Sometimes it may be necessary to stimulate the heart of an asphyxiated victim. Of the mechanical means which do not require any surgical intervention, a vibratory massage consisting of rapid tapping (100 per minute) directly over the heart area is the most effective. To execute

this properly, it is better to use a supine position rather than a prone one.

On the other hand, various authors claim that artificial respiration itself serves to stimulate the heart through changes in pressure. Bruns[5] and Héderer[9] investigated the effect of the various methods of respiration upon the intracardiac pressure in a cadaver. Table II gives the results.

TABLE II

EFFECT OF THE VARIOUS METHODS OF ARTIFICIAL RESPIRATION UPON INTRACARDIAL PRESSURE

Methods	Intracardial Pressure in cm. of Water	
	Expiration	Inspiration
Silvester	+18	—8, —12
Howard	+18	—1
Schafer	+12, +14, 0*	+9, 0*
Schafer-Héderer	+12, +16	—5, —9

Compiled from Bruns[5] and Hèderer.[9]

* As soon as cadaver was laid upon stomach, pressure in the heart rose 12 cm. and remained so without any significant change throughout the test.

Although figures for a similar test with Nielsen's method are not available, it may be assumed with certainty that they would have been close to those for the Schafer-Héderer test. Obviously, the Schafer-Drinker figures would be the same as those for the Schafer-Héderer method.

Bruns observed that artificial respiration caused a flow of the venous blood into the left heart, although the amount was very small. However, he thought that artificial respiration, driving some blood to and from the heart in an ebb and flow manner, stimulated the heart. If his assumption is correct, then the method giving the greatest changes in intra-cardial pressure is the best. On this basis, Silvester's method would rank first, and Schafer's last.

Mijnlieff and Watermann[3] injected potassium ferrocyanide into a femoral vein of a monkey whose heart had been stopped by asphyxiation. Stoppage of the heart was ascertained through the use of a cardiograph. In forty-five minutes of artificial respiration, the chemical reached the femoral artery of the other leg. Although the investigators admit that this will do little good in the case of an apparent death, yet they concluded that Silvester's method provided the best circulation of the blood. Since no other method has been tried, it is impossible to accept their qualification of the best method: *"Car elle favorise au mieux la circulation du sang."*

In resuscitating an apparently dead person shortly after asphyxiation has occurred, one is never sure whether or not the heart is still. A lack of pulse does not necessarily mean that the heart has completely stopped, for the heart continues to beat for several minutes after the cessation of respiration. According to Bruns and Thiel,[24] action current

was present thirty minutes after the heart had apparently stopped; this makes the recovery of the heart itself possible.

An injection of adrenalin directly into the heart has coincided with a successful resuscitation, but, as was remarked by Y. Henderson, in all such cases there was no evidence that the heart was still. On the other hand, Hyman,[25] after reviewing an extensive literature, says that there is no proof that adrenalin is responsible for the restoration of heart activity, since a mere needle prick produces the same effect. It is to be noted, however, that Sellheim believes that the introduction of a needle into the heart may be fatal if a big blood vessel is broken.

Petrov[26] succeeded in resuscitating asphyxiated animals twelve to eighteen minutes after heart action had stopped, using stimulation of the sciatic nerve for this effect. However, the animals died within twelve hours and acted as decerebrate animals. Complete restoration has been achieved only when the heart has not been stopped for more than five minutes.

In this laboratory, where over a hundred animals have been used in experiments on drowning, we have never been able to revive the animal nor restore the heart action by artificial respiration alone, after the heart had stopped, as far as could be determined clinically. However, cessation of heart action was not the primary cause of failure of resuscitation. As far as it was possible to determine, the animals died because the respiratory passages were hopelessly blocked by foam and water, and sufficient lung ventilation could not be effected.[31] To sum up, it is clear that a method in which the victim is lying on his back is more favorable because the pressure variation in the heart chambers is greater, and a heart massage, if desired, can be performed easily.

Methods of Artificial Respiration

ARTIFICIAL RESPIRATION

In considering this topic, one is immediately confronted with a number of statements, mostly speculative in nature. Table III is a compilation of actual and imaginary dangers which investigators attribute to the various methods of artificial respiration.

A glance at this table shows that the accusations are about the

TABLE III

Dangers to the Body Arising from Application of the Various Methods of Artificial Respiration

Method	Harm Attributed to Method
Silvester:	Broken ribs, ruptured liver, broken teeth, suffocation by vomited masses, tongue falling back.
Howard:	Broken ribs, ruptured liver, suffocation by vomited masses, tongue falling back.
Schafer:	Broken ribs, ruptured liver, injury to the kidneys, suffocation by the vomited masses.
Nielsen:	Broken ribs, compression of mammary glands.

same for all methods. Fewer items against Nielsen's method may be explained on the basis that it is the newest system. Injury to the mammary glands is probably imaginary; according to Nielsen, even full-breasted women suffer no discomfort. On the other hand, it would probably be difficult to rupture either the liver or the kidneys with this method. "Dangers" of the Schafer method obviously may be also ascribed to the Schafer-Drinker method.

In considering the broken ribs, one should make certain that they were not broken during the accident. When Jellinek[32] cited a case of twelve broken ribs through the use of Silvester's method, Mijnlieff retorted in defense that probably "an ox jumped on the man." He also remarked that in Holland in the past thirty years there have been no cases of broken ribs due to the use of Silvester's method. Mijnlieff, in turn, cites two cases of broken ribs upon application of Howard's method. Schafer[27] also says that in a public demonstration Howard himself broke several ribs of his elderly subject. Drinker and Shaw[11] warn against the use of Nielsen's method, because the upper ribs may be broken easily. On the other hand, Sillevaerts[28] states that Nielsen's method has an advantage over Schafer's because pressure is applied in a place which is less fragile than the lower ribs. Waters and Bennet[29] think that Schafer's system is more dangerous than Nielsen's. This is merely a supposition.

In connection with this discussion, it is of interest to examine data showing the amount of pressure exerted upon the chest of a subject during various types of artificial respiration. All the operators were Springfield College students, well trained in manual resuscitation methods. The subjects were placed upon flat scales, and a reading taken; this "resting pressure" was taken as zero. With the subjects still on the scale, the artificial respiration was applied, and the increase in pressure on the scale noted.

The data obtained are tabulated in Table IV.

From Table IV, it may be seen that pressure in any method may reach 100 pounds or more quite easily. Since it takes about 90 pounds to break the ribs of an elderly person, it is obvious that great care

TABLE IV

PRESSURE APPLIED TO THE CHEST IN ARTIFICIAL RESPIRATION (in pounds)

Method	Positive Pressure			Aver. Negative Pressure
	Average	Maximum	Minimum	
Schafer	72.9	98	36	
Silvester	65.6	125	4	—42.8
Howard	81.2	110	35	
Nielsen	79.9	130	20	—28.5
Alabama Power	105.9	170	82	
Schafer-Drinker	68.4	130	35	—30.27

must be exercised in artificial respiration. The American Red Cross wisely suggests that only about 30 pounds pressure be used. This is difficult to do unless the knees of the operator are placed above the knees of the victim, or unless the operator rests on one knee.

The possibility of a ruptured liver through use of Silvester's method is also noted in Table III. If this is true, then anything can happen with this method.

As to suffocation, here again we are confronted by conflicting statements. It seems that suffocation may occur either in a prone or in a supine position. In a prone position, with the head slightly lower than the rest of the body, this danger is minimized, but not entirely excluded. In the Alabama Power method, pressure may exceed 170 pounds. Such a pressure may lead to a squeezing of the stomach content up into the throat, with dangerous consequences.

Mijnlieff, in his histological studies of the lungs of drowned mice and dogs, substantiated earlier reports that alveoli are often ruptured after drowning. He also found that after the application of artificial respiration, which consisted of chest compression, these ruptures were "frightful." [30, 4] This may serve as a warning against very energetic compression of the chest with any method.

Another hazard is that of the tongue falling back; some authors suggest the use of tweezers to prevent this. This suggestion should be condemned as unnecessary cruelty. The tongue will be bruised, swollen, and will cause discomfort and pain for several days.

In summing up, we may say that Howard's method, with direct pressure upon the rib cartilages, seems to be more dangerous than the others. No one of the remaining four methods has any advantage which places it in preference to the others. An excited, heavy life-saver may be equally dangerous with any method.

EASE OF LEARNING AND APPLICATION

There seems to be general agreement that Schafer's method is easier to learn and to apply. This is even admitted by the defenders of the Silvester and Nielsen methods. Because of the similarity between Schafer and Howard techniques, the Howard method should be equally easy to learn and to apply.

CONCLUSIONS

Which method, then, is the best?

It is obvious from this review that at the present time all the leading methods (Silvester, Howard, Schafer, Nielsen, and Schafer-Drinker) are about the same; although the Howard method is under suspicion as a potential menace to ribs and liver.

Scientific findings are as yet inadequate, and the endorsement by "official committees" has only a nominal value. Although the decisions of the committees may be politely unanimous, their verdicts are nothing

more than the opinions of a few persons, and they usually have little value outside the native land.

More studies are necessary for a further clarification of many problems involved in artificial respiration.

But what should our attitude be at present?

In a case of asphyxiation, other than drowning, each method seems to be equally useful. In drowning, if due to a partial blocking of the respiratory passages, a greater aspiratory force is desired, and the Schafer-Drinker or Nielsen methods are preferable. When there is need for a heart massage, simultaneous with the application of artificial respiration, then Silvester's or even Howard's method should be used.

Which method should be taught?

This raises a serious social-pedagogical problem. Y. Henderson is of the opinion that since millions of Americans are familiar with Schafer's method, we should continue to teach it rather than introduce confusion by teaching another method. Undoubtedly any change in method would cause considerable confusion; in an emergency, even an inferior method immediately applied is more effective than a superior one used too late because of indecision.

It is for this reason that a conservative attitude may be worth while. An advanced life-saver should be taught all these methods, but we may continue to teach the average life-saver the orthodox prone method, until a very good reason is given for the adoption of some other method.

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The Status of the Effect of Gelatin on Muscular Fatigue

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THE reports of Boothby [1]* and Wilder [7] that glycine is of therapeutic value in the treatment of muscular atrophies and dystrophies, especially in cases of myasthenia gravis, aroused considerable interest in the possibility of delaying the onset of fatigue, due to muscular activity, by feeding gelatin which is approximately 25 per cent glycine.

Since the investigations reported give results which are in wide disagreement as to the effects of gelatin on the onset of fatigue, a critical examination of the published reports seems to be in order.

Ray, Johnson, and Taylor [6] conducted an experiment in which they fed gelatin to six men and four women. They proceeded by training their subjects for a period of two to three weeks by having them do work on a bicycle ergometer, until they could perform their maximum amount of work as constantly as could be expected before fatigue set in. After the training period three of the women took 45 gms. gelatin and one took 67.5 gms. daily during the experimental period. All male subjects took 60 gms. of gelatin daily. The gelatin was administered in 8 ozs. of orange and lemon juice. After the experimental period, a post-experimental period was carried out during which the subjects were given the fruit juices without the gelatin. The results of the experiment were reported in terms of energy developed during a period of work on the bicycle ergometer. This experiment showed that in the case of two women, 3 per cent more energy was developed during the period that they were fed gelatin. Apparently, the other female subjects failed to show an increase. For the men, the energy generated by means of the ergometer increased in all cases, the amount varying from 37 to 240 per cent.

Hellebrandt [2] investigated the effect of gelatin on the ability of six young adult women to perform "maximal anerobic work" on a bicycle ergometer. Her method was essentially like that employed by Ray except that she used "maximal anerobic work" whereas Ray evidently employed less than maximal. Hellebrandt found no increase in the ability of her subjects to do work. Also, she pointed out that her subjects could easily maintain a work output which was two or three times

* Superior figures refer to numbered Bibliography at end of article.

the maximum attained by Ray's male subjects, and that the curves presented for the male subjects could be explained on the basis of training, disregarding any action of gelatin.

In a report of a series of experiments by Maison,[5] it is stated that "Ray's subjects were obviously incompletely trained. They were working daily to complete bodily fatigue. It is unlikely that such fatigue is completely overcome in 24 hours. Thus two simultaneous processes might be occurring in these subjects, that is, training tending to increase work ability, and accumulating fatigue (overexercising) tending to decrease work ability. At first, the former process might predominate and increase ability. Later, a plateau might occur, and later still, staleness would predominate and the work ability decrease. If gelatin were administered early and discontinued as the second process gains dominance, a curve such as Ray's would result."

Maison [5] performed a well-controlled experiment in which male subjects fatigued the extensor digitorum communis muscle daily, by doing work at a uniform rate. Fatigue was defined as appearing when a subject could not maintain the rate of work. In order to differentiate between the ability of the neuromuscular system from the combined neuromuscular and circulatory systems, the right arm of each subject did its daily work without its blood supply, whereas the left arm had its circulation intact during the work. The subjects were divided into two groups: Group one was used to show the effect of gelatin on muscles in the process of rapid training. The results were negative since in the midst of the training period the ingestion of gelatin for from 20 to 30 days produced no obvious differences between the progress of training during gelatin ingestion and that which occurred either before or after gelatin was taken.

A second experiment was carried out by Maison to determine the effect of gelatin on the ability of thoroughly trained muscles to do work. In two subjects, trained for one year, the ingestion of 15 gms. of amino acetic acid per day for 30 days failed to increase the ability of the extensor digitorum communis muscle to do work, working either with or without its blood supply. Likewise, the ingestion of gelatin for 40 days gave negative results.

An experiment reported by Kaczmarek [3] gave interesting results. He studied the effect of feeding gelatin on the ability of ten athletes, ten non-athletes, and twelve women to do work. By having a subject pedal a bicycle ergometer, the daily energy output of work was recorded in foot-pounds. The athletes worked to exhaustion for 4 weeks, daily except Sundays, eating their regular diet. Following this, the group worked for 6 weeks, daily except Sundays, receiving 1.5 ozs. of gelatin each day. On the average, the athletes did 216 per cent more work per day when receiving the gelatin.

Likewise 10 non-athletes worked through a preliminary period of 3

weeks, followed by 3 weeks of work during which gelatin was added to their diet. We assumed that the amount of gelatin eaten was the same as for athletes. The non-athletes showed an average daily increase in ability to do work amounting to 52 per cent.

The experiment dealing with women was carried on over a period of 12 weeks, that is, 2 preliminary, 4 training, 4 on gelatin, and 2 post-gelatin. The improvement in work at the end of the gelatin feeding period amounted to 501 per cent.

The results obtained by Kaczmarek are so extraordinary that they deserve special attention. The increase in performance is approximately 90 per cent greater, for athletes, than that found by Ray, and is in direct opposition to the results reported by Ray and Hellebrandt for women. Although Kaczmarek evidently did not carry the experiment on athletes and non-athletes through a post-gelatin feeding period, this was done in the case of the women. During the 4-week training period, there was an increase in ability to do work which continued during the gelatin feeding period. It is significant to note that after the gelatin was discontinued the ability to do work remained 394 per cent greater during the first post-gelatin week and 209 per cent higher during the second post-gelatin week when the experiment was discontinued.

Kaczmarek's experiment is subject to the same objection as that of Ray. An examination of the data shows what we believe to be a typical training curve in which there is a gradual increase in ability to do work, until finally a plateau is reached, after which the individual continues on a higher plane of efficiency. The final drop shown by the data is not uncommon in training curves and may be due to the fact that accumulating fatigue due to daily exhaustive work overcomes the training effect, and predominates.

One of the difficulties which may lead to erroneous results in experiments where the onset of fatigue, or complete exhaustion is the end point is that there is no way available for defining these phenomena sharply enough so that they may safely be used quantitatively where the combined neuromuscular system is involved. It has been demonstrated over and over again that the onset of fatigue or complete exhaustion may be altered by any number of uncontrollable factors. If the individuals taking part in an experiment of this nature even suspected that gelatin was being added to their diets, their ability to do work would no doubt be increased.

Also if the mere addition of gelatin to the diet increases work output by as much as 200-500 per cent, there should be no difficulty in demonstrating its effect on direct muscle work where a sharply defined end point is possible. Knowlton [4] found no significant differences. Furthermore, if such benefits are derived by gelatin feeding, it is unusual to find such a discrepancy in experimental results, that is, from

no effect to several hundred per cent betterment, where investigators are employing similar methods.

It should be recognized that the calorific value of the food intake during the course of experiments involving work output must be controlled. In any experiment involving physical training based on bouts of strenuous exercise the tendency is to increase the food intake even to the extent of overcompensation for the additional work. This increased caloric intake alone is sufficient to account for an increase in the capacity to do work.

In the experiment reported by Knowlton [4] the feeding was forced and the diet controlled. He was unable to demonstrate any significant effect due to the addition of gelatin to the diet.

SUMMARY

Up to the present time, the results of carefully controlled experiments indicate that the increase in ability to do work ascribed to gelatin is evidently due to other factors. An apparent betterment in performance in athletic competition where gelatin has been added to the diet has been observed and is no doubt real. In such instances, the psychologic factor must not be overlooked. This falls into the same category as the swimmer who can plunge much farther after a breath of air which he thinks is oxygen.

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The Integrated Post-Exercise Pulse-Product as a Measure of Physical Fitness

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THE problem considered is the assessment of physical fitness in a group of college women, by a test devised for this purpose. The report is concerned with the development and standardization of such a test, the analysis of its physiological bases, and its evaluation by comparison with independent criteria of physical fitness. The college students taking the test were classified on the basis of their performance. It is proposed that in accordance with this scale, students may be assigned to appropriate physical activities which will not over-tax their capacities and from which they may obtain benefit rather than injury.

BASIC CONCEPT OF PHYSICAL FITNESS

Pembrey's[5] * concept of physical fitness (1908) as being relative and not necessarily meaning good physique, is accepted as the point of view from which to approach this study. The efficient performance of work involves the interaction of all body systems; the condition is so complex and the power to adjust so great that no single measurement can be an infallible guide.

A MEASUREMENT OF CARDIOVASCULAR FUNCTIONAL CAPACITY

Many methods have been proposed for the measurement of physical fitness. In the present study, measurement of efficiency of cardiovascular functional condition has been chosen as one of the most sensitive and most inclusive indices of physical fitness. The return to the pre-exercise level of the heart rate, the pulse pressure and their product, the pulse-product, have been followed and on the basis of their comparison, the pulse product is proposed as a measure of physical fitness. This measure was suggested by Erlanger and Hooker[3] (1904) who regarded the pulse-product as indicating the minute volume of the heart. Dawson[1, 2] (1906) and (1935) reports continued use of the pulse pro-ruct with certain cautions. Rosen and White[7] (1926) compared the pulse product with minute volume determined by ethyl iodide method

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* Superior numbers refer to Bibliography at end of article.

and found them in fair agreement when the subjects were standing, doing light exercise, and immediately after heavy exercise. Schneider[8] (1939) reports the use of this indirect method for the determination of minute volume. In all the foregoing experimental work, the subjects were not in a state of rest or basal condition. Read and Barnett[6] (1936) found a closer agreement between the minute volume and product of the pulse rate and pulse pressure when the experimental work was done with the subjects in basal condition. The work of these authors and others indicated a relationship between the product of heart rate multiplied by the pulse pressure and minute volume.

In this study the pulse-product was used as an indication of the minute volume of the heart. Upon this estimate of minute volume a curve was drawn to represent the total recovery period. This curve accurately measured by the use of a planimeter gave an arbitrary unit which was used as the measure of physical fitness. Statistical analysis of the data in terms of millimeter beats (pulse pressure $\times$ pulse rate), rather than liters of cardiac output, gives the basis for the rating scale. The measurement of the recovery curve gave consistent results. The subjects who took the longest time to recover and whose recovery data resulted in the largest area incurred the greatest oxygen debt. These subjects were said to be the least fit and were placed in the lowest decile of the scale of physical fitness.

EXPERIMENTAL PROCEDURE

The subjects were healthy, young college women. The medical examination, which included the recommendation of the family physician as well as that of the college physician, rated them as normal in the medical sense. In age the range was 17 to 23, a few graduate students and all four undergraduate classes being represented.

Two subjects, F.C. and C.L., took the test a number of times under different physiological conditions. It was desired to know the variability as an indication of the reliability of the test; in addition, the possible effect on the subject of taking the test at different times of day as well as the effect of taking the test while in a basal or post-prandial condition must be known.

The subject upon coming to the laboratory began a rest period which varied in length with the subject. Her height and weight had been taken and the arm cuff of the sphygmomanometer placed on her right arm before she started the rest period in a reclining position. During this rest period the following information was recorded: data, time of day, age, surface area, and menstrual history. After 15 or 20 minutes, blood pressure and pulse-rate readings were taken and repeated until the cardiac index was within the limits of Grollman's value for the cardiac index, that is $2.2 \pm .3$.

The formula $P.P. \times P.R. \times K$ was used for the purpose of converting the pulse-product data to an estimate of cardiac output. The

constant, K, is used in the formula in order to give recognition to the variability in size of the subjects. Read and Barnett state:

> Blood flow is equal to pulse rate times stroke volume. The pulse rate can be determined easily, and the problem is to find a clinical measure of the stroke volume. In a given individual, stroke volume is approximately proportional to pulse pressure. This does not hold in persons of various sizes, since a large heart pumps more blood per stroke at the same pulse pressure than does a small one. Some factor of size must therefore be introduced before stroke volume can be expressed in terms of pulse pressure. The surface area of the body seems to be the most satisfactory measure for this purpose.[6]

It would follow then that K would be a constant having a different value in each person. The average value has been derived from the data of this study which gives 1.58 as the value of K for young women between the ages of 17 and 23. The only average we have with which to compare this value for K is that of Grollman who gives 1.7 as K for young men.

The calculation for K was accomplished by dividing the resting output (or level) in terms of millimeter beats into the product of the surface area times the cardiac index. The values for surface area were obtained from the DuBois chart for determining the surface area of man in square meters from weight and height. Cardiac index is defined by Grollman as the cardiac output in liters per square meter of body surface. His value for the cardiac index is $2.2 \pm .3$.

To illustrate, the following calculations will give the value of K for one subject:

Cardiac output = surface area × cardiac index
1.7 = surface area for this particular subject
2.2 = cardiac index in liters per min. per sq. meter of surface area
1000 = multiple used to convert liters into cc.
1796 cc./min. = Resting output in millimeter beats for subject tested

$$\frac{1.7 \times 2.2 \times 1000}{1796} = \frac{3740}{1796} = 2.08\ K \text{ for this subject}$$

In a similar manner the value for K was computed for 88 subjects with the following results:

Surface Area	Number of Cases Used in Average	K-Averaged Value	K-Weighted Average
1.3	1 case	1.36	1.36
1.4	7 cases	1.41	9.87
1.5	25 cases	1.55	37.59
1.6	28 cases	1.64	45.93
1.7	18 cases	1.64	29.53
1.8	7 cases	1.65	11.54
1.9	2 cases	1.58	3.16
	88 cases	10.83	138.98
		$7 = 1.54$	$88 = 1.58$

The only use that was made of an actual estimate of cardiac output was that of attempting to standardize the resting level. Experience indicated this technique to be better than one of having the subject rest a certain length of time before exercise. Some subjects came to a resting level of pulse rate and pulse pressure within twenty minutes; others were in a reclining position for almost an hour before the resting cardiac index was approximated.

For standard exercise the subject walked on a motor-driven treadwheel for two minutes at a fixed speed. The wheel, two wooden discs, 28 inches in diameter with steps 9 inches apart built in between, is hung on a frame work. The fixed axle of the wheel is set in two stationary bearings. A fixed sprocket wheel is placed on this axle in order to control the action of the wheel.

A Tycos Recording Sphygmomanometer was used for blood pressure reading because of the desire to have a graphic and objective method of determining the blood pressure. This is one type of machine used in clinics, research laboratories, and hospitals. It has been particularly satisfying to be able to check any doubtful readings, or to go back and re-read the sphygmotonograms in an attempt to interpret the results obtained. The use of this instrument has made it possible to compare the results of the tests given to the senior high school girls with those given to the young college woman with much more assurance that the data are comparable.

A stop watch was used for the timing of the two minutes of exercise and for the reading of the pulse rate. The pulse was counted at the radial artery of the left arm.

The subject, having rested until readings for heart rate and blood pressure gave the resting level in millimeter beats, steps upon the revolving wheel. The activity is exactly like stair climbing except that the revolution of the wheel drops the subject, and she must lift her weight up to the next step. An iron railing which comes up over the wheel, serves as a place on which the hands of the subject may rest. This eliminates the element of loss of balance or unnecessary effort in neuromuscular control. During the two minutes of exercise the tread wheel rotates at such a rate that the subject is forced to raise her own weight ninety times per minute: a climb of 180 steps in two minutes.

Immediately following this exercise the subject takes a supine position. The connections of the arm sleeve to the recording sphygmomanometer and the inflation of the pressure cuff are accomplished in sufficient time to give the first reading at 30 seconds after the exercise stops. The blood pressure and heart rate readings are taken simultaneously throughout the experiment, and continued until the millimeter beats product has returned to the resting level.

Environmental conditions under which the experiment was conducted were kept as favorable as possible. The room was quiet and com-

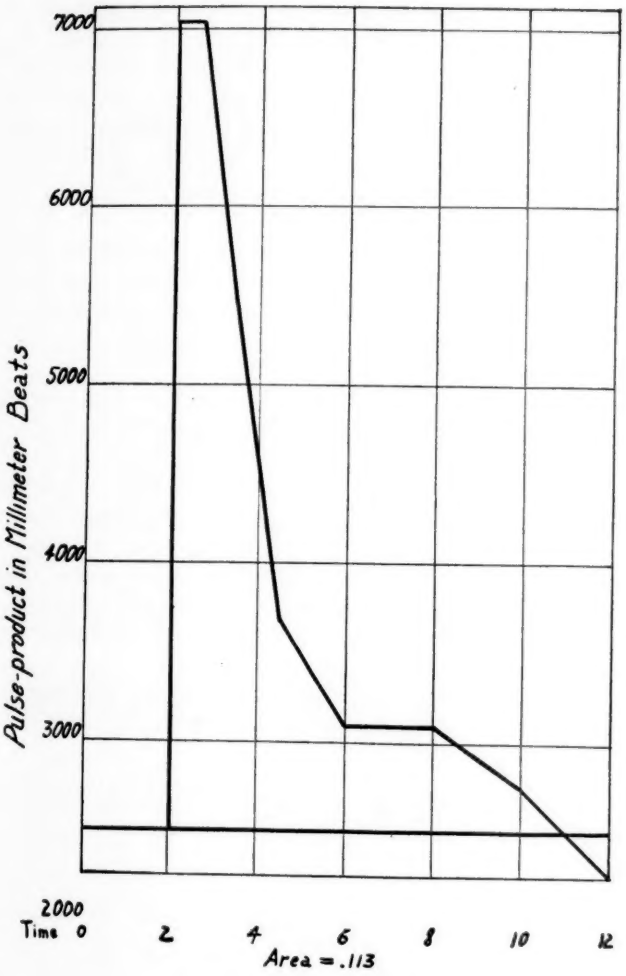

FIG. I. Recovery curve.

DATA RECORD SHEET
(See Fig. I)

Age 20 Weight 115 S.A. 1.58 MMB. 2496
Height 5′ 5″ Mens. 5/14/39 C.I. 2.4 Liters 3.94

	1	2	3		4	5	6	7	8	9	10
T	4:10				2:30	3:30	4:30	6	8	10	12
HR	66	66	64		100	86	74	72	74	72	72
S	108	103	102	Exercise	152	143	124	124	105	100	100
D	62	64	63		84	82	74	66	63	62	68
PP	46	39	39		68	61	50	43	42	38	32
MMB	3036	2574	2496		6800	5246	3700	3096	3108	2736	2300
L	4.89	4.06	3.94								

fortably warm. The experimenter wrote pulse rate and blood pressure findings for the recorder. In a few cases the subject, after resting for some time, was found to have an output far in excess of the standard desired for the resting level. Questioning brought out the fact that there was a lack of mental or emotional repose. In such cases, the test was not given.

RESULTS

In order to study the after effects of the standard exercise upon systolic and diastolic pressures, pulse pressure and heart rate, five types of curves were drawn. The general properties and relationships of the different curves were treated in the original study but will not be reported upon at this time.

The measure of physical efficiency was estimated by constructing recovery curves for each subject from the data collected during the post-exercise period (see Figure I, a record sheet for data from which the recovery curve was plotted). The base line of the graph is the resting level in millimeter beats, while the abscissa is the recovery time and ordinate the product of ($P.P. \times P.R.$) per minute in millimeter beats. The results obtained were plotted on millimeter graph paper. The curve thus obtained was measured by a planimeter and the total area determined. The arbitrary set of values is in a scale of planimeter readings ranging from .087 to .82.

The following analysis of the data from the repeated tests on F.C. is made on the basis of the planimeter values for the area under the recovery curves of these tests.

A.M. Basal		P.M. Basal		P.M. Post-Prandial	
7/13/37	12.5	7/17/37	11.3	7/13/37	13.0
7/15/37	16.3	7/20/37	14.2	7/14/37	14.0
7/16/37	11.0	7/21/37	13.0	7/15/37	15.0
7/18/37	14.6	7/24/37	10.9	7/18/37	13.7
7/19/37	13.0	7/28/7	9.9	7/19/37	15.6
7/26/37	8.2	7/30/37	13.0	7/26/37	11.7
7/29/37	12.0	8/ 4/37	8.4	7/29/37	12.0
8/ 2/37	12.9	8/ 6/37	14.7		
8/ 8/37	16.3	8/ 7/37	15.7		
Average Area = 12.978		Average Area = 12.351		Average Area = 13.571	

Considering the data first from the point of view of the coefficient of variation shown in the tests taken under similar conditions, we have:

	$\overline{X}$	N	Sx	V
A.M. Basal	12.978	9	2.552	19.66%
P.M. Basal	12.351	9	2.647	21.43%
P.M. Post-Prandial	13.571	7	1.453	11.56%

The second series of tests given to F.C. for five days in succession gave the following results:

Averages

Tests taken before breakfast	8 A.M.	$\frac{64.7}{5} = 12.95$
Tests taken after breakfast	9:30 A.M.	$\frac{85.2}{5} = 17.04$
Tests taken before lunch	11:30 A.M.	$\frac{61.4}{5} = 12.28$
Tests taken after lunch	2 P.M.	$\frac{75.1}{5} = 15.02$
Average for the 20 tests		$\frac{57.29}{4} = 14.32$

The range of variability represented in the series is much greater than that given by the first series. The effect of the exercise taken after the subject had eaten, in each case was one of increased oxygen consumption, a greater oxygen debt being incurred by the tests taken after breakfast than those taken in the afternoon. The two series of tests taken just before the subject ate either breakfast or lunch show the very close average value of 12.94 and 12.28, with the greater degree of physical efficiency appearing in the afternoon. From these data the following per cent variability results:

$\overline{X}$	N	Sx	V
14.32	20	6.263	43.73

Combining the data for both series of tests:

	$\overline{X}$	N	Sx	V
A.M. Basal	12.978	9	2.552	19.66%
P.M. Basal	12.351	9	2.647	21.43%
P.M. Post-Prandial	13.571	7	1.435	11.56%
20 Tests	14.32	20	6.263	43.73%
Total mm.	13.54	45	4.59065	12.01%

The results of this series of tests agree with those reported by Erlanger and Hooker,[8] wherein there was observed an increase of both pulse pressure and pulse rate following the ingestion of food.

Repeated tests for variability taken by C.L. were given over a period of fifteen consecutive days.

Average area for the fifteen tests—22.24.

$\overline{X}$	N	Sx	V
22.24	15	4.631	30.84%

The uniformity of the test results for F.C. with the increased cardiac output and oxygen debt following only in the tests taken immediately after meals was interpreted as an indication that the test was reliable. On the basis of these findings the test was given to the college and high school students either in an A.M. basal condition or later in the afternoon.

STATISTICAL ANALYSIS

The log values of the score for all the students were plotted and gave what apparently was a normal curve; this was tested in two ways, first by calculation of the moments of the distribution and second by the chi square test. In the first case the third and fourth moments by methods of Fisher lead to the following parameter estimates:

$g_1 = -0.0675$	$Sg_1 = 0.2597$	$P = 0.88$
$g_2 = -0.4858$	$Sg_2 = 0.1625$	$P = 0.01$

The value of g_1 derived from the third moment is not significantly

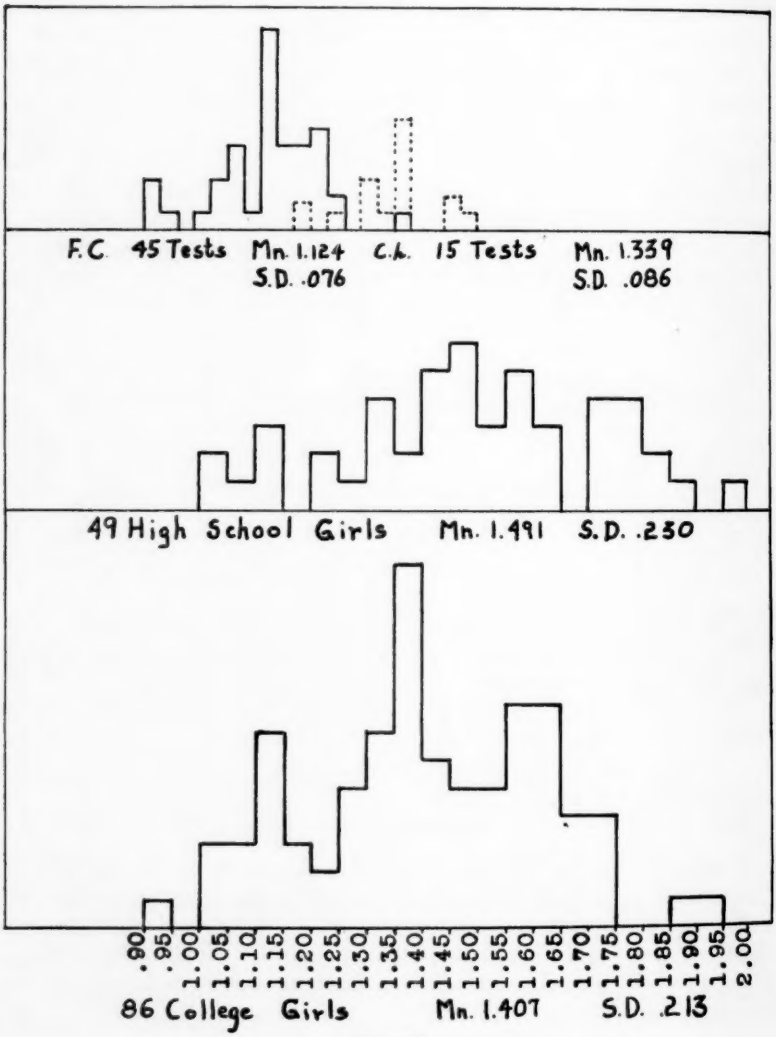

FIG. II.

different from *o*, the value for the normal curve, so it may be concluded that there is no skew. The value of g_2 is negative, indicating a platykurtic distribution and is significant. Symmetrical but somewhat flat topped, the distribution can be treated for the present purpose as normal without serious error.

Calculation from the original ungrouped data gave a mean of 1.407 and a standard deviation of .2133. This would correspond to a geometric mean of the original area of .255. The data from the variability tests of F.C. and C.L. were treated in the same way.

The following table will give the comparison of the total group with the variability tests results of these two girls.

Subjects	Mm. Mean	S.D.	Coef. of Variability
F.C.	1.124	.076	6.75
C.L.	1.339	.086	5.22
86 college students	1.407	.213	15.16

A senior high school study made by Miller[4] (1938) duplicated the techniques of testing and the use of data employed in the college study. The age range for the high school group was from 14 to 18 years, and the grade placement was tenth, eleventh, and twelfth.

All tests were given to this group of girls after 2:30 P.M., many of them being given between 4 and 6. The mean for this group was 1.491 with a standard deviation of .230 and a variability score of 15.442.

Comparing these with the college group:

	Mean	*S.D.*	*Coef. of Variability*
86 college students	1.407	.213	15.16
49 senior high school	1.491	.230	15.44

As might be expected, the mean of the high school group is lower than the college group, the difference in means being 6.5 per cent with an 8 per cent difference in standard deviations. Figure II gives graphically the close similarity in the results of these two studies. Age level and physiological functional capacity as found in comparing these two groups does not show any great difference in range.

SCALE OF LEVELS OF PHYSICAL FITNESS

Use of the Ogive curve based on the assembled data indicated the decile placement of each of the subjects. Since the area represented an estimate of cardiac output and oxygen debt for the total recovery period, the subject having the largest area and therefore the greatest oxygen debt ranked lowest on the scale. The individual who was in good physical condition recovered in a shorter time, and incurred a smaller oxygen debt than a less physically efficient individual. The sub-

jects who were most efficient ranked in the highest or tenth decile and were arbitrarily given a rating of superior.

The scale of levels of physical fitness which resulted from this treatment of the data shows the wide range of individual differences represented in the group tested.

The tenth decile	—ranked as superior	—included cases 1– 7
The ninth decile	—ranked as excellent	—included cases 8–16
The eighth decile	—ranked as very good	—included cases 17–24
The seventh decile	—ranked as good	—included cases 25–33
The sixth decile	—ranked as above average	—included cases 34–43
The fifth decile	—ranked as average	—included cases 44–50
The fourth decile	—ranked as below average	—included cases 51–60
The third decile	—ranked as fair	—included cases 61–68
The second decile	—ranked as poor	—included cases 69–77
The first decile	—ranked as very poor	—included cases 78–86

Our immediate interest is focused on the subjects who fall in the lowest decile group. They present a problem of proper adaptation of physical education activities to the physiological capacities of each student found in this group. The following scale of probability is calculated for those whose oxygen debt was great enough to place them in the area of the curve of probability which represents two or three standard deviations below the mean calculated for the eighty-six college students.

					Case Numbers
Mean:	1.4069	*SD* + .213	*SD*	*P*	45
	1.6800	.2731	1.282	.10	79
	1.7062	.2993	1.405	.08	81
	1.7211	.3142	1.475	.07	82
	1.7573	.3504	1.645	.05	84
	1.8444	.4375	2.054	.02	85
	1.9023	.4954	2.326	.01	86

A case similar to that of 86 might be expected to occur once in 100 times, one similar to 85 might occur twice in 100 cases, 84 or a subject of similar physiological capacity, might be expected to appear 5 times in 100 cases; 82, 7 times; 81, 8 times, and 79, 10 times.

The indications of a probability that the girls referred to by case numbers above should not participate in the more strenuous physical activities such as competitive basketball or hockey are very strong. When it is remembered that each subject had on the basis of her medical examination been authorized to participate in any activity which she wished to elect, the test results become more meaningful. To the writer they indicate a need for a great deal of research in both the field of evaluation of the physiological capacities of individuals and in the field of evaluation of the activities offered in the physical education program, for the physiological demands which they make upon the human organism.

CORRELATION OF DECILE PLACEMENT WITH MEDICAL EVIDENCE OF FITNESS

One of the efforts to learn the correlation of these test results with other evidence of fitness was an attempt to compare the decile placement of students who had taken the original test with a rank placement made by physicians as a result of medical examinations. Within a period of two weeks, eight subjects picked from various positions on the decile scale were given the standard test. They were re-examined by the college physician and were given both an electrocardiographic and fluoroscopic examination by another physician. As a result of each of the series of medical examinations, the subjects were ranked in order according to the evidence of physical fitness indicated. None of the three examiners knew of the rating of the others, since the examinations were being carried on simultaneously.

The order in which the eight subjects are ranked as the result of the two medical examinations and the standard test is as follows:

Standard Test	*Electrocardiograph and fluoroscope*	*Heart examination by college physician*
35	35	35
3	3	3
F.C.	F.C.	6
70	70	F.C.
45	45	70
6	6	
69	69	69
80	80	80

The agreement is striking, the correlation being perfect in one case, and $e = .893 \pm .0538$ (P.E.). It would seem to indicate the validity and sensitivity of the test as a measure of one aspect of physical fitness. That is, a measure of the cardiovascular functional condition of the subject.

The wide range of individual differences found at each age level is of particular interest to the physical educator. The enormous differences observed in the recovery effects on the subjects after participation in the standard exercise makes evident the need for more accurate measurement of functional power as a basis for classification for participation in physical activity.

Perhaps the greatest utility of this test lies in its use for the detection of the small number of students, possibly only those in the lowest decile, which are likely to suffer injury from strenuous exercise. It is proposed to develop a shorter and perhaps a more simple test which will be as accurately controlled as to the standard amount of work done and the measurement of recovery. A short, simple, yet more valid test of cardiovascular condition than we have now, which could be given by the teacher of physical education, would be of great value.

SUMMARY

1. The recovery process of 135 girls and young women, who had participated in a standard exercise, was observed.

2. The exercise consisted of climbing 180 steps in 2 minutes on an electrically driven treadwheel.

3. The recovery effects were computed from a planimeter measurement of the recovery curves.

4. From a statistical analysis of the results, a scale of levels of physical fitness was constructed for the subjects tested.

5. This scale was shown to correlate highly with other criteria of fitness.

6. It is shown that an efficient and sensitive scale is provided for detecting impaired cardiovascular conditions.

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Some Effects of Summer Camping on the Physical Development of Boys

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FOR many years camp directors and counselors have been "selling" camping to the parents of American youth. One of the chief selling points has always been that camping contributes greatly to the physical development of its clients. The directors have found themselves in a dilemma, however, because of conflicting opinions of what really constitutes development. Many parents think of development only in terms of increased poundage, while it is a known fact that boys undergoing the activity of a camping season can't gain much, if any, weight. Therefore, several problems have presented themselves rather forcefully to camp directors. What constitutes physical development? How can you prove that camp is benefitting the boys if they show a loss in weight? How important is gaining weight?

THE PROBLEM

With the above mentioned questions uppermost in mind, the writer, who was a counselor in a small camp, undertook learning the answers through the media of tests in the field of physical education.

First, however, "physical development" had to be defined and tests selected. For this study the following tests were employed: the ACH Index of Nutritional Status,[1]* Foster's Pulse Return Test,[2] MacCurdy's Physical Capacity Test,[3] and McCloy's Technique for the Prediction of Normal Weight.[4]

Knowing the importance that the average parent places on weight, it was given special consideration. It is believed by the best authorities that knowledge of a boy's actual weight is of little value without the accompanying knowledge of how much he should weigh. It is also fairly well established that the traditional "age-height-weight" tables are of little value because they deal only with averages and do not consider factors of build. Consequently a new criterion had to be found. For this McCloy's technique of determining predicted weight fitted our needs best.

In summary, it might be pointed out that in this attempt to learn the effects of summer camping on the physical development of boys,

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This paper is an abstract of the writer's master's thesis on file in the University of Texas Library.

* Refer to numbered Bibliography at end of article.

the following factors were measured at the beginning and end of a six-week camping period: nutritional status, cardiac efficiency, strength, physical capacity, and actual weight in comparison to normal weight.

All tests were administered to thirty-two boys in Camp Idlewhile, located near Wimberly, Texas, on the Blanco river.

PREVIOUS WORK IN THE FIELD

The writer was unable to find references to much testing that had been done in the camping field. None was found referring to the use of a comprehensive battery of tests, measuring many factors. Several were found that had used the Rogers P.F.I.[5] These studies are reviewed in Table I.

TABLE I

SUMMARY OF PREVIOUS STUDIES

Investigator	Period	Number Tested	Number Gaining	Number Losing	Per Cent Gain	Name of Camp	Location
Glovin[6] ...	1 and 2 weeks	189	142	47	17	Not listed	
Malcolm[7] .	2, 4, 6, or 8	149	133	16*	19.8	Y.M.C.A.	New York
Wylie[8] ...	2, 3, 4, 6, or 8 weeks	140	105	31	8	Camp Waubeeka (Boy Scout)	
Wright-stone[9] ..	8 weeks	50	30	20	7	Camp Brooklyn	New York

*13 of these stayed only two weeks. Malcomb thinks that this fact is significant.

ACTIVITIES IN CAMP IDLEWHILE

The activities at Camp Idlewhile were much the same as in other privately owned camps, but in order to give a complete background for this study they will be tabulated. Working on the basis of a 144-hour week, time distributions were approximately as follows:

Sleep and rest	72 hours
Swimming	12 hours
The after-dinner program	12 hours
Eating	6 hours
Free time allowed after meals, changing from one activity to another, etc.	15 hours
Horseback riding	4 hours
Archery	4 hours
Camp craft	4 hours
Minor sports	4 hours
Hiking, scouting, coaching classes, and riflery	6 hours
Canoeing and boating	2 hours

TABLE II

STATISTICAL SUMMARY OF ALL DATA

	The ACH Index of Nutritional Status*		Foster's Pulse Return Test		MacCurdy's Physical Capacity Test		Variations from Normal Weight†		MacCurdy's Strength Test	
	Before	After	Before	After	Before	After	Before	After	Before	After
Range	−.2—8.8	2.0—10.5	3—15	4—15	28—413	33—477	0—25	0—23	408 to 2065	441 to 1990
Mean	4.06	6.40	9.22	10.72	136	159	8.10	9.40	1027	1206
S. D. of the distribution	.63	.67	.58	.52	.67	.80	1.16	1.07	77.7	80.0
Difference between means	2.34		1.50		23		1.3		179.0	
S. D. of difference between the means	.85		.80		1.04		4.1		111.4	
Critical ratio	2.75		1.90		22.50		.32		1.6	
Chances in 100 that difference is a real one	99 plus		97		99 plus		63		94	
Number improved	12		18		28		7		30	
Per cent improving	80		56.2		87.5		23.3		93.7	
Number decreasing	3‡		10‡		4		17‡		2‡	
Per cent decreasing	20		31.3		12.5		56.7		14.8	

*Since the ACH norms are available only up to 12 years of age only 15 cases were used.
†Based on the difference between normal weight as predicted by McCloy's technique and actual weight.
‡ Others remained the same.

STATISTICAL STUDY

After both batteries of tests had been given, the raw scores were arranged in frequency distributions and treated statistically to ascertain the following factors: range, mean, standard deviation, standard deviation of the mean, difference between the means, standard deviation of the difference between the means, critical ratio, and the chances in 100 that the difference was a real one. The number and percentage of campers showing gains and losses in each test were also determined. Table II gives a summary of all statistical data. For the sake of brevity, the writer will forego detailed specific comments on the statistics themselves, and devote that space to general interpretations and the recommendations that were made to camp supervisors as a result of this study.

MAIN FINDINGS

The main findings of this study can be summarized as follows:

1. The camping experience was definitely beneficial to the nutritional status of the boys since all but three showed an improvement in nutrition after camp, as measured by the ACH Index. One of the three showing a loss actually improved himself since he was overweight anyway. Two others raised their status from below the minimum set by ACH to well above at the close of the camping season.

2. The camp routine showed positive results in regard to strength as measured by the MacCurdy technique. Thirty of the 32 boys tested showed a mean increase of 142 pounds (all the factors in this test are measured in pounds), and the percentage, 93.7, of those taking this test and showing improvement was the highest of that found for all tests.

3. The physical capacity of 87.5 per cent of the boys tested showed a mean gain of 141 points in the MacCurdy Test for measuring this factor. The critical ratio, 22.5, was the highest of all the tests given and indicates complete reliability.

4. According to the Foster Pulse Return Test, the strenuous activity in camp was detrimental to the cardiac efficiency of 31.3 per cent of the boys while 56.2 per cent showed a mean gain of 11 per cent in Foster scores.

5. The theory, advanced by many camp promoters and believed by many parents, that camping will add weight to its clients was not supported according to this study. Only 12 campers, representing 41.4 per cent, showed a mean net gain of 3 pounds, while 13, or 44.8 per cent, had a mean net loss of 2.2 pounds, and 4 remained the same. It might be pointed out that some of the boys who lost weight actually improved their "actual weight-normal weight" status since they came to camp in an overweight condition.

6. When the normal weight, as predicted by the McCloy technique,

was brought into the picture, it further substantiated the thesis that camping does not add weight. In the study minuses and pluses were disregarded. Only deviations from the normal were given consideration regardless of whether or not the subject was over- or underweight. It was found that before camp the mean deviation from the normal was 8.1 pounds, but after camp it had risen to 9.4 pounds. Seventeen of the 29 boys tested, (3 of our subjects could not take this test because they were thyroid cases) were further from their predicted weight after camp than before, and 6 retained the same difference between actual and predicted weights. Only 23.3 per cent improved their "actual weight-normal weight" status.

THE WRITER'S RECOMMENDATIONS TO CAMP SUPERVISORS

As a result of this study the writer would like to make the following recommendations to camp supervisors:

1. By all means install some kind of testing program so that the camping program can be fitted to the individual needs of the boy.

2. Keep permanent records of your findings and use them not only during one season but from year to year to watch the individual's progress. Testing stimulates interest. It will aid materially in proper grouping for competitions, and gives objective proof to parents of beneficial results.

3. Of the tests used in this study, the writer ranks them according to their potential value in the following order: First, MacCurdy's strength and physical capacity tests; second, McCloy's technique for prediction of normal weight; third and fourth (tie), the Foster test and the ACH Index.

4. If you go to the trouble to set up a testing program, use your results in grouping for competition in prescribing special diets for under- and overweight campers, and for deciding upon the amount of activity a boy can safely engage in.

5. The records can be made to work for you if used correctly. Use them to sell camp.

6. Be honest with yourself. Use the results to check up on yourself. If your results over a period of years are negative, find out what is wrong with your camp. Do not be afraid of facts. If correctly employed they will help you.

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Race and Stature; A Study of Los Angeles School Children

By Orren Lloyd-Jones, Ph.D., M.D.

IT IS a common opinion in the United States that, compared to "American Whites" the Japanese, and to a less extent the Mexicans, are physically small peoples whereas the Negro ranks among the tall races. We present here data which throw light on these racial differences as seen among school children in Los Angeles. These data were collected through the agency of the Work Projects Administration in connection with the School Health Aid Project sponsored by the Los Angeles Board of Education. The study, made specifically for the preparation of standard height-weight-age tables for use in Los Angeles schools, comprises altogether a total of 163,008 children distributed as follows:

White	121,820
Mexican	22,354
Negro	5,142
Japanese	3,692

The manner in which the data were collected has been described elsewhere;[1] in general the procedures conformed to practices generally accepted in such mass investigations. Certain studies on the white school population have already been published;[1] the present paper compares white with Negro, Mexican, and Japanese children. It considers (1) the average height for age and average weight for age, and (2) average weight for height, of the several races.

The fundamental data for these studies is displayed in Tables I and II, drawn up in conventional style as a height-weight-age table, but with four columns under each age for the four races concerned. The table also shows (in bold face type) the number of children from which each value was derived. In assembling the raw data into the present table they have been subjected to the simplest arithmetic procedures. Only extreme individual variants were excluded, the arbitrary limits for exclusion adopted were 30 per cent under and 60 per cent over the modal weight for height at the given age. Averages are arithmetical means. The data for the white children are massive, averages based on frequencies less than 15 were omitted entirely, and modal frequencies generally lie between 700 and 800. Almost no "smoothing" has been necessary in the case of the white data, scarcely two dozen average weights have been altered among them, and with three exceptions the

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1 Orren Lloyd-Jones, "California Tall Children," *American Journal, Diseases of Children*, July, 1940.

alteration has consisted of adding or subtracting not more than a pound. In the case of Negroes, Mexicans, and Japanese, however, because of the smallness of the samples, considerable "smoothing" has been justified to give the statistical symmetry which inheres in such material.

AVERAGE WEIGHT PER AGE AND AVERAGE HEIGHT PER AGE

These figures are derived by direct calculation from those in the body of the table and are shown in Tables III and IV for height, and Tables V and VI for weight. To make comparison easy, there is shown in addition, the amounts by which the several races deviate from the white. All the deviations from the white shown in Tables III to VI are minus excepting 8, and these 8 plus values occur in columns for the Negro, the tallest of the non-white races. The minus deviations for Mexicans and Japanese are distinctly larger than the Negro. The deviations of the Negroes, Mexicans, and Japanese from the whites are (twelve-year-old boys, for example) of the following order of magnitude: height per age, inches, −.5; −1.5; −2.5; weight per age, pounds, −2; −5; −7.

Charts I to IV display the same data graphically. A glance at them reveals a clear cut gradation of the four races in regard to both height for age and weight for age. The sequence, downward, is white, Negro, Mexican, and Japanese. The constancy with which these relative positions are maintained at the various ages is indeed striking; the curves never coincide nor intersect except in the 8 cases above mentioned where Negroes excel. The general form of the growth curve is closely similar for the four races. The curves tend to separate fanwise at thirteen years (girls) and fifteen years (boys), the deviations increasing with maturity.

The girls tend to level off at sixteen years, but the boys display very little of that tendency even at eighteen years. This would seem to imply that the female adults of the four races would differ in about the same degree as do the eighteen-year-old girls, but that the males when adult would possibly show greater deviations from the white than occur among the eighteen-year-old boys. Contemporary data on average adult statures are not available to check these implications.

AVERAGE WEIGHT PER HEIGHT

With these definite and constant racial differences in average height per age and average weight per age in mind, it would seem, at first thought, highly improbable that any height-weight-age standards which are based on measurements of "white children" could even approximately serve as standards by which the Mexicans and Japanese, for example, could be judged. One might be inclined to feel that Mexicans and Japanese, because they are smaller people would invariably be recorded as "underweight" when judged by such tables. But remember that the conventional height-weight-age table is not designed to com-

pare races in average height and weight but to evaluate individuals. So long as the weight of the Mexican or Japanese child of any given age bears the same relation to *its own height* as does the weight of the white child to its own height, then the standard values given in height-weight-age tables for white races will be adequate for the Mexicans, Japanese, and Negro children, no matter how extreme are the differences in weight and height *per age*.

Weight for height in adults is to a degree a valid measure of body type. Among individuals of the same height it does in a rough way depict the stocky, "lateral," or the stretched out "linear" patterns. But in growing youth the weight for height is a shifting value, and subject to puzzling vagaries. In making such racial comparisons of body type among children of the same height, the first impulse is to study the average weight for height of the several races, regardless of age. These figures are set down in the four left-hand columns of Tables I and II. They do in truth represent the average weight of each race for the given height, yet they often give a false idea of the physiological relationship of the races. For example, (Table I) at height 66″ the average weight of Japanese boys is 1 pound greater than the white, yet when one examines the average weight of the individual age groups at that height, paradoxically the Japanese is from 1 to 3 pounds *lighter* than the white. This discrepancy is the result of the age differences which exist between the 66″ Japanese and 66″ white boys. Many white boys attain 66″ in height at 12 years, and more of them at 13 and 14 years (refer to proper age columns in Table I) whereas none of our Japanese boys reached 66″ till age 15. Now with increasing maturity, even at the same height, goes increase of weight. The presence of these younger and therefore lighter groups of white boys, in the averages struck for the entire lot of 66″ children, results in the misleading conclusion that the Japanese are inclined to a stockier build whereas the opposite is true when *comparable ages* are used. By comparable ages is understood those ages in which both races (i.e. white and the race which is being compared) are represented in the table. When averages are derived in this way, as above stated, we discover that the Japanese 66″ boys are actually 2 pounds (average) lighter than the 66″ white boys. A similar lack of coincidence between the ages of various races at a given height is seen throughout the Table but is more pronounced in the taller children. This circumstance invalidates, in the case of children, the use of averages which disregard the age distribution factor as a basis for comparing the races in body type (i.e., weight per height).

The method finally adopted to make such racial comparisons in weight for height was to compare each of the three races separately with the white, using only the ages in which both races are represented. These tables are bulky and their use is restricted entirely to

TABLE I—BOYS
Average Weight for Age and for Height of Four Races

Hgt. in Ins.	Av. Wgt. per Hgt.				5 Years				6 Years				7 Years				8 Years				9 Years				10 Years				11 Years			
	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.
39			35	36			35	36																								
							7	5																								
40	37		37	37	37		37	37			37																					
					28		26	4			23																					
41	38	38	39	39	38	38	39	38	39	39	39	39				39																
					68	6	50	11	42	6	41	10				3																
42	40	39	40	40	40	39	40	40	40	40	40	40	41		41	40																
					155	10	67	13	116	7	76	13	10		20	4																
43	42	41	42	42	42	41	42	42	42	42	42	42	43		42	42				42												
					265	7	71	43	266	15	146	17	54		38	9				4												
44	44	43	44	44	44	43	43	44	44	43	44	44	44	44	44	44	46		44	45												
					300	9	69	6	466	25	195	30	125	5	99	10	15		9	6												
45	45	45	46	46	45	45	45		45	45	46	46	45	46	46	46	47		46	47			47									
					269	8	38		658	28	199	15	255	15	162	27	62		42	6			8									
46	48	47	48	48	48	47	48		48	47	48	48	48	48	48	48	48	48	48	49			49	49								
					188	7	25		747	30	134	8	514	24	191	21	124	10	109	17			18	5								
47	50	49	50	51	50	49	49		50	49	50	50	50	50	50	50	50	50	50	51	51		51	52			52					
					95	6	6		669	31	84	7	729	30	220	18	257	22	151	28	50		42	13			6					
48	52	52	53	53	52				52	51	52		52	52	52	52	52	52	53	53	53		53	54	53		54	54			55	
					52				488	21	38		879	38	173	9	494	26	201	35	122		118	21	16		40	5			6	
49	56	54	55	56					54	53	54		55	54	54	55	55	54	55	56	55	54	55	56	57		57	57	59		58	
									232	10	13		726	34	88	6	682	31	234	24	259	11	145	37	58		50	13	11		9	
50	58	57	59	59					57				57	56	58		57	57	58	59	58	57	58	59	59	57	59	59	60		60	60
51	62	60	62	61					114				599	24	62		840	29	191	17	507	27	223	33	162	11	106	19	31		31	16
									60				60	58	61		61	60	61	61	61	60	61	61	61	60	62	62	63	61	62	62
52	64	63	64	64					45				337	12	24		827	37	127	5	719	31	202	28	329	16	146	24	108	9	67	13
									61				62	60	63		63	63	63	63	64	63	64	64	64	63	64	64	65	64	65	65
53	68	67	68	69					16				199	5	11		629	31	63	3	864	47	195	22	510	27	181	25	209	14	108	27
													66				66	66	66		67	66	67	67	67	66	67	67	69	67	68	69
54	72	70	71	73									71				400	12	30		752	32	126	9	714	36	187	19	375	18	155	26
													69				69	69	70		70	69	70	69	70	69	71	70	71	70	71	72
55	75	73	75	76									31				252	12	16		652	29	73	8	826	38	163	16	572	33	212	31
																	73				73	71	73	73	74	72	74	74	74	73	74	75
56	78	77	78	80													108				484	19	30	5	832	34	124	7	762	34	190	21
																	74				76	74	76		78	75	77	77	78	76	77	80
57	81	81	82	84													56				274	11	15		688	21	79	3	859	40	148	16
																	79				80		78		81	79	80		81	80	81	84
58	86	86	86	90													13				128		7		464	13	25		821	32	138	7
																					83				85	84	83		85	84	85	87
59	90	90	91	93																	54				265	13	10		668	28	74	6
																					86				89				89	87	89	89
60	95	93	96	99																	29				159				495	14	36	3
																									92				94	90	93	
61	100	98	100	105																					74				285	10	21	
																													98	94	98	
62	105	102	107	110																									147	8	5	
																													102			
63	112	108	112	114																									87			
																													106			
																													91			

TABLE I—BOYS (*Continued*)
Average Weight for Age and for Height of Four Races

TABLE I—BOYS (*Continued*)
AVERAGE WEIGHT FOR AGE AND FOR HEIGHT OF FOUR RACES

Hgt. in Ins.	Av. Wgt. per Hgt.				12 Years				13 Years				14 Years				15 Years				16 Years				17 Years				18 Years			
	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.
51	62	60	62	61	67		63																									
					20		**11**																									
52	64	63	64	64	68	67	66	66	68																							
					51	**8**	**30**	**8**	**13**																							
53	68	67	68	69	70	69	69	70	72		69	72																				
					109	**9**	**49**	**13**	**25**		**15**	**4**																				
54	72	70	71	73	71	71	72	74	73		72	75	80			76																
					242	**22**	**110**	**27**	**75**		**26**	**4**	**20**			**2**																
55	75	73	75	76	75	74	75	77	76	76	76	78	81		76	79																
					430	**21**	**131**	**28**	**137**	**5**	**48**	**9**	**28**		**13**	**3**																
56	78	77	78	80	79	78	78	80	79	80	80	81	83		80	32																
					634	**27**	**183**	**21**	**247**	**13**	**83**	**18**	**71**		**20**	**8**																
57	81	81	82	84	81	82	82	84	83	83	83	84	84		84	85			84													
					832	**45**	**173**	**23**	**411**	**20**	**92**	**26**	**109**		**44**	**13**			**6**														
58	86	86	86	90	85	86	86	88	85	87	87	88	87	88	88	89	90		88	93				95								
					837	**32**	**142**	**14**	**541**	**15**	**124**	**26**	**180**	**6**	**37**	**15**	**67**		**6**	**7**				**3**								
59	90	90	91	93	89	90	90	91	89	91	91	91	92	92	92	94	93		93	96				98								
					749	**33**	**104**	**16**	**597**	**21**	**117**	**14**	**304**	**8**	**85**	**15**	**110**		**29**	**5**				**3**								
60	95	93	96	99	94	94	94	95	94	94	95	96	94	95	96	98	97		97	99	99		100	102			105					
					688	**25**	**79**	**2**	**712**	**27**	**113**	**16**	**441**	**10**	**77**	**13**	**162**		**16**	**10**	**32**		**10**	**2**			**3**					
61	100	98	100	105	98	98	98	100	98	98	99	100	99	99	100	102	99	101	102	104	101		105	106	110		110					111
					488	**27**	**39**	**4**	**674**	**35**	**93**	**20**	**497**	**19**	**105**	**15**	**255**	**8**	**55**	**13**	**68**		**21**	**12**	**19**		**2**					**4**
62	105	102	107	110	102	101	102		102	101	104	105	103	102	105	106	106	105	107	108	108		109	110	114		114	114				115
					327	**14**	**25**		**565**	**21**	**66**	**10**	**573**	**23**	**87**	**24**	**309**	**14**	**74**	**23**	**116**		**28**	**12**	**33**		**11**	**12**				**2**
63	112	108	112	114	106	104	108		107	105	108	109	109	107	110	110	111	110	111	112	114	115	114	114	120		117	118	124		119	119
					197	**8**	**17**		**494**	**27**	**52**	**9**	**624**	**24**	**86**	**14**	**437**	**17**	**81**	**24**	**169**	**10**	**58**	**18**	**74**		**24**	**14**	**22**		**12**	**5**
64	116	114	117	119	110	108			112	109	112		112	111	115	114	115	115	116	116	118	119	118	118	122	123	120	122	125		122	123
					105	**6**			**375**	**15**	**29**		**631**	**25**	**69**	**14**	**500**	**25**	**96**	**31**	**285**	**23**	**71**	**17**	**124**	**6**	**43**	**21**	**65**		**11**	**14**
65	121	120	121	122	116				116	114	115		117	117	119	118	119	120	120	120	123	123	122	122	127	126	124	125	128		126	126
					58				**251**	**12**	**16**		**549**	**23**	**69**	**17**	**601**	**28**	**79**	**24**	**446**	**23**	**89**	**17**	**248**	**11**	**47**	**14**	**79**		**21**	**14**
66	126	126	125	127	121				121	120	119		123	123	123		125	124	125	124	127	127	126	125	131	130	128	129	132	134	129	129
					21				**169**	**8**	**10**		**450**	**34**	**46**		**652**	**29**	**80**	**12**	**530**	**30**	**91**	**26**	**379**	**25**	**39**	**17**	**158**	**8**	**20**	**15**
67	130	132	128	130	123				125		123		127	127	126		131	128	128	127	132	131	130	129	134	134	131	132	135	138	133	132
					20				**99**		**6**		**327**	**19**	**22**		**649**	**16**	**52**	**4**	**639**	**32**	**61**	**14**	**454**	**27**	**30**	**12**	**192**	**14**	**24**	**3**
68	134	136	134	134					131				131	131	130		132	132	132	130	135	135	134	133	138	138	135	136	140	144	137	136
									59				**279**	**19**	**14**		**574**	**17**	**29**	**7**	**638**	**24**	**39**	**8**	**501**	**23**	**27**	**6**	**240**	**15**	**27**	**2**
69	138	140	138	139					133				137	135			138	136	135		139	140	138	138	141	143	139	140	143	148	141	140
									20				**154**	**7**			**373**	**21**	**16**		**568**	**8**	**37**	**6**	**446**	**16**	**21**	**7**	**253**	**14**	**14**	**5**
70	144	146	142										142				142	140			144	144	141		146	147	142		146	152	144	
													106				**262**	**14**			**427**	**11**	**14**		**389**	**17**	**11**		**248**	**12**	**4**	
71	146	151											143				143				146	147			149	150			150	155		
													55				**163**				**264**	**11**			**299**	**8**			**192**	**10**		
72	153																152				152				152				157			
																	65				**159**				**187**				**131**			
73	157																154				155				156				162			
																	23				**63**				**106**				**48**			

Figures in Bold Face are Frequencies

TABLE II—GIRLS

Average Weight for Age and for Height of Four Races

Hgt. in Ins.	Av. Wgt. per Hgt.				5 Years				6 Years				7 Years				8 Years				9 Years				10 Years				11 Years			
	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.
39			35				35																									
							21																									
40	36	34	36	36	36	33	36	36		35	36	36																				
					41	3	35	5		4	26	3																				
41	37	36	37	38	37	36	37	38	37	36	37	38			37																	
					112	10	60	8	45	4	54	8			6																	
42	38	38	39	40	39	39	39	39	39	38	39	40			40	41																
					182	11	65	6	165	14	110	22			21	4																
43	41	40	41	42	41	41	41	41	41	40	41	42	41		41	42																
					287	19	72	7	321	22	173	19	67		69	11																
44	43	42	43	43	43	43	43	42	43	42	43	43	43	42	43	43			44	44												
					277	14	47	3	551	29	190	20	126	7	120	14			22	6												
45	45	44	45	45	45	45	45		45	44	45	45	45	44	45	45	45	45	45	45			45	47								
					264	15	32		702	34	159	19	290	22	177	20	44	4	53	11			7	4								
46	47	46	47	48	47	46	47	48	47	46	47	48	47	46	47	48	47	47	48	48	47		48	48								
					137	4	12		710	32	127	9	563	26	201	28	158	10	115	14	24		20	4								
47	49	48	50	50	49	47			49	48	49	50	49	48	49	50	49	48	50	50	50		50	50			50	51				
					58	6			572	27	69	2	752	40	201	8	312	15	143	28	82		58	19			13	2				
48	52	51	52	53	51				51	50	51		51	51	51	53	52	51	52	53	52	52	53	53	54		53	53			53	
					33				388	10	14		834	54	150	7	527	16	200	28	157	11	103	19	40		18	4			6	
49	54	53	54	56					54	52	54		54	53	54	56	54	53	54	56	54	53	55	56	55	53	55	56			55	
									181	8	6		676	42	81	4	691	22	178	18	330	16	132	41	73	8	58	17			12	
50	57	55	57	59					57	54			57	54	57	58	57	55	57	58	57	56	57	59	58	56	57	59	59	56	58	59
51	60	58	60	61					78	6			511	13	43	3	879	41	172	14	558	20	173	28	218	4	103	14	40	9	33	8
									60				60	56	60		60	57	60	61	60	58	60	61	60	58	60	62	63	60	61	62
52	64	61	63	64					32				273	10	16		757	35	108	6	714	32	192	19	365	12	170	25	105	4	67	11
													63	59	62		63	59	63		63	61	63	63	64	62	64	64	65	63	64	64
53	67	65	67	67									127	6	7		526	21	52		818	44	162	14	507	23	175	22	166	9	93	21
													66				66	61	65		67	65	67	66	67	66	67	68	67	67	67	68
54	70	68	70	70									53				356	19	27		796	40	106	4	730	32	212	26	353	12	135	26
													69				70	64	68		70	67	69	68	70	68	69	71	70	70	71	71
55	74	72	75	75									27				216	10	10		590	22	61	5	777	35	153	14	512	20	136	27
																	73				73	69	73		74	72	73	73	74	73	74	74
56	78	76	78	78													68				406	19	22		753	26	103	13	705	29	158	36
																	76				76	74	77		77	75	77	76	77	77	77	77
57	84	80	86	85													26				227	17	12		617	28	67	7	802	35	158	17
																					80				81	78	81		81	80	83	81
58	90	83	92	91																	102				437	19	33		764	21	111	16
																					84				85	81	84		85	82	87	85
59	96	93	96	96																	48				272	14	16		675	24	92	9
																									87		89		89	87	91	89
60	100	101	103	100																					157		15		527	25	57	3
																									92				93	91	95	
61	104	105	106	104																					69				362	17	28	
																									95				98	95	99	
62	107	110	110	107																					42				233	7	20	
																									96				103		105	
63	113	113	114	111																					22				130		6	
																													109			
																													28			
																													144			

TABLE II—GIRLS (*Continued*)
AVERAGE WEIGHT FOR AGE AND FOR HEIGHT OF FOUR RACES

Hgt. in Ins.	Av. Wgt. per Hgt.				12 Years				13 Years				14 Years				15 Years				16 Years				17 Years				18 Years			
	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.	Wht.	Neg.	Mex.	Jap.
51	60	58	60	61			62																									
							18																									
52	64	61	63	64	66		65	64																								
					36		**21**	**12**																								
53	67	65	67	67	68		68	68			71																					
					85		**39**	**11**			**5**																					
54	70	68	70	70	71	70	72	71	74		73	71																				
					176	**9**	**68**	**19**	**30**		**16**	**5**																				
55	74	72	75	75	75	73	76	74	76		76	76			79	77																
					290	**10**	**106**	**22**	**59**		**31**	**4**			**4**	**3**																
56	78	76	78	78	77	77	80	77	78	79	80	80	86		81	82			87													
					403	**13**	**89**	**28**	**124**	**6**	**46**	**20**	**28**		**8**	**5**			**6**													
57	84	80	86	85	81	81	84	82	82	83	85	84	87		86	86	95		91	88			95	92								
					570	**25**	**147**	**35**	**232**	**10**	**68**	**20**	**64**		**22**	**13**	**25**		**5**	**7**			**8**	**5**								
58	90	83	92	91	86	84	88	86	88	87	89	88	92		91	90	97		95	93	104		98	96			99	100			99	
					642	**27**	**145**	**21**	**348**	**15**	**139**	**23**	**136**		**60**	**21**	**55**		**45**	**21**	**31**		**30**	**13**			**16**	**16**			**5**	
59	96	93	96	96	89	90	92	90	91	92	94	92	98	92	97	94	99	97	100	97	105	101	101	99	105		102	103	106		102	106
					749	**26**	**139**	**17**	**512**	**29**	**141**	**28**	**258**	**11**	**113**	**30**	**139**	**7**	**81**	**32**	**109**	**15**	**52**	**15**	**68**		**37**	**13**	**38**		**12**	**8**
60	100	101	103	100	94	93	98	94	97	97	100	95	99	97	103	98	106	102	105	100	107	106	106	102	108	111	107	106	108	112	108	108
					690	**22**	**98**	**17**	**662**	**29**	**186**	**26**	**455**	**23**	**121**	**47**	**321**	**14**	**120**	**25**	**256**	**23**	**76**	**38**	**179**	**12**	**57**	**33**	**75**	**7**	**13**	**18**
61	104	105	106	104	100	99	102	97	102	102	103	99	105	102	108	101	108	106	108	104	109	111	109	106	110	114	111	110	111	115	113	110
					620	**23**	**51**	**4**	**761**	**33**	**125**	**16**	**654**	**30**	**138**	**22**	**544**	**31**	**125**	**32**	**419**	**23**	**102**	**32**	**291**	**19**	**47**	**27**	**152**	**9**	**15**	**8**
62	107	110	110	107	105	102	105	100	105	105	106	103	108	107	111	105	111	111	112	108	113	114	112	109	113	116	114	113	114	117	115	113
					491	**14**	**41**	**4**	**767**	**42**	**68**	**8**	**836**	**38**	**124**	**24**	**722**	**32**	**123**	**17**	**698**	**45**	**101**	**15**	**482**	**26**	**46**	**15**	**240**	**12**	**15**	**12**
63	113	113	114	111	109	104	108	103	111	108	109	108	112	110	113	109	114	115	116	111	116	116	116	113	116	118	118	117	116	119	119	117
					347	**12**	**22**	**3**	**680**	**29**	**50**	**3**	**855**	**30**	**66**	**14**	**854**	**43**	**94**	**11**	**820**	**37**	**83**	**17**	**628**	**19**	**38**	**14**	**307**	**16**	**14**	**4**
64	116	117	119	116	113				114	112	112	113	116	114	115	113	119	118	118	115	119	119	121	117	120	120	123	120	120	121	124	120
					178				**529**	**27**	**25**	**4**	**728**	**33**	**53**	**4**	**842**	**34**	**57**	**6**	**889**	**31**	**65**	**12**	**673**	**37**	**38**	**3**	**300**	**5**	**7**	**5**
65	120	120	122	121	115				118	114			118	117	118		121	121	119	119	122	122	124	121	123	123	125	125	124	123	126	123
					108				**326**	**8**			**578**	**22**	**13**		**687**	**37**	**32**	**2**	**721**	**15**	**38**	**3**	**567**	**24**	**17**	**3**	**259**	**9**	**7**	**0**
66	124	122			119				122	117			124	120			124	123			125	124			127	125			127	125		
					43				**143**	**5**			**284**	**14**			**474**	**14**			**533**	**16**			**373**	**9**			**214**	**4**		
67	129	126							125				127	124			128	126			129	126			131	127			132	127		
									71				**157**	**6**			**239**	**8**			**281**	**6**			**202**	**6**			**96**	**0**		
68	132								126				132				132				132				133				135			
									22				**65**				**128**				**150**				**138**				**56**			
69	135												134				134				135				136				136			
													19				**49**				**60**				**51**				**14**			
70																																

Figures in Bold Face are Frequencies

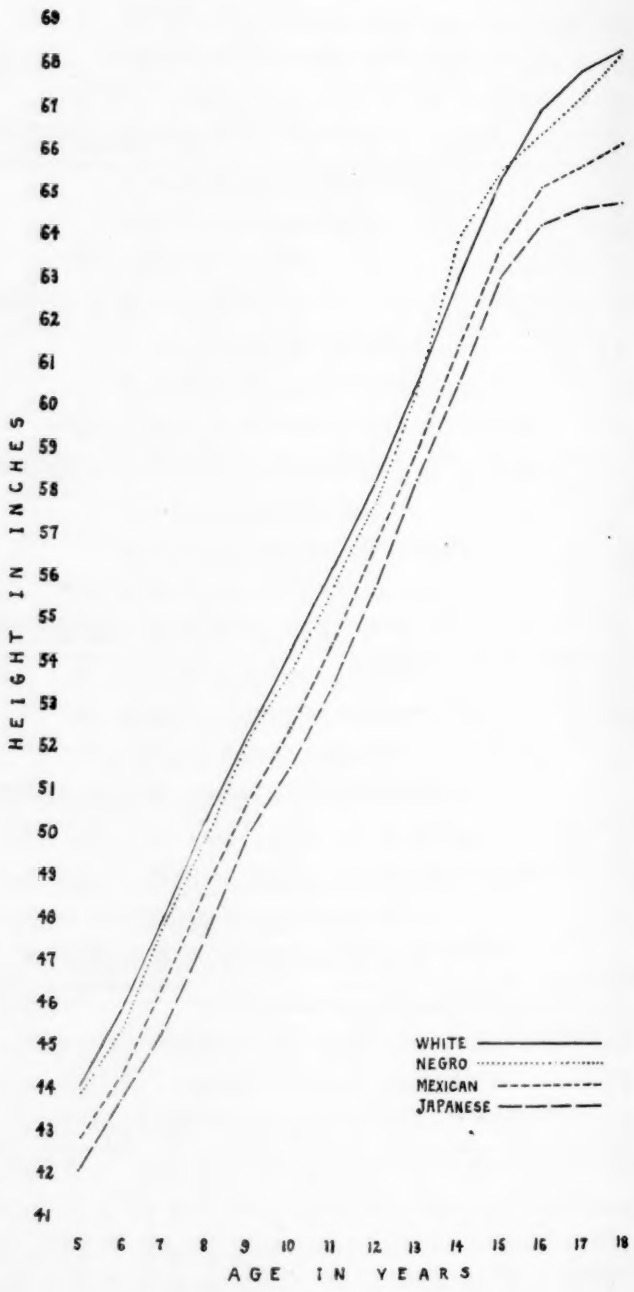

CHART I. Height for age, boys of four races.

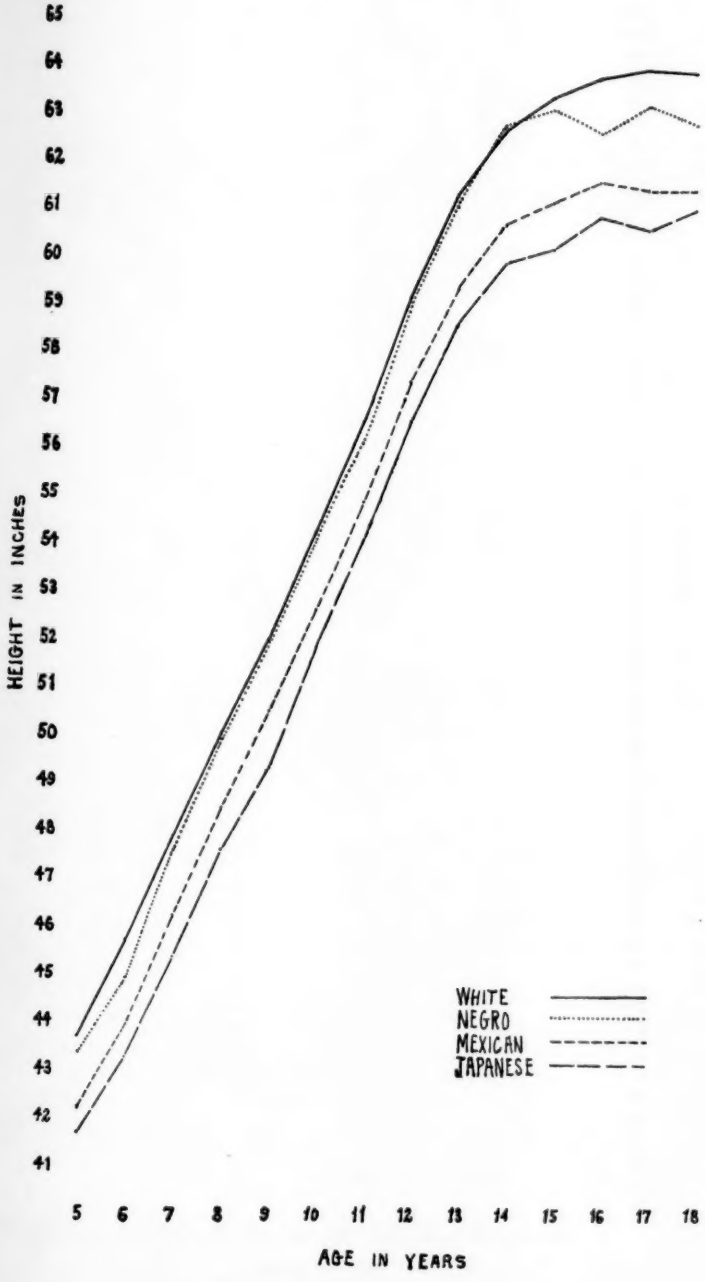

CHART II. Height for age, girls of four races.

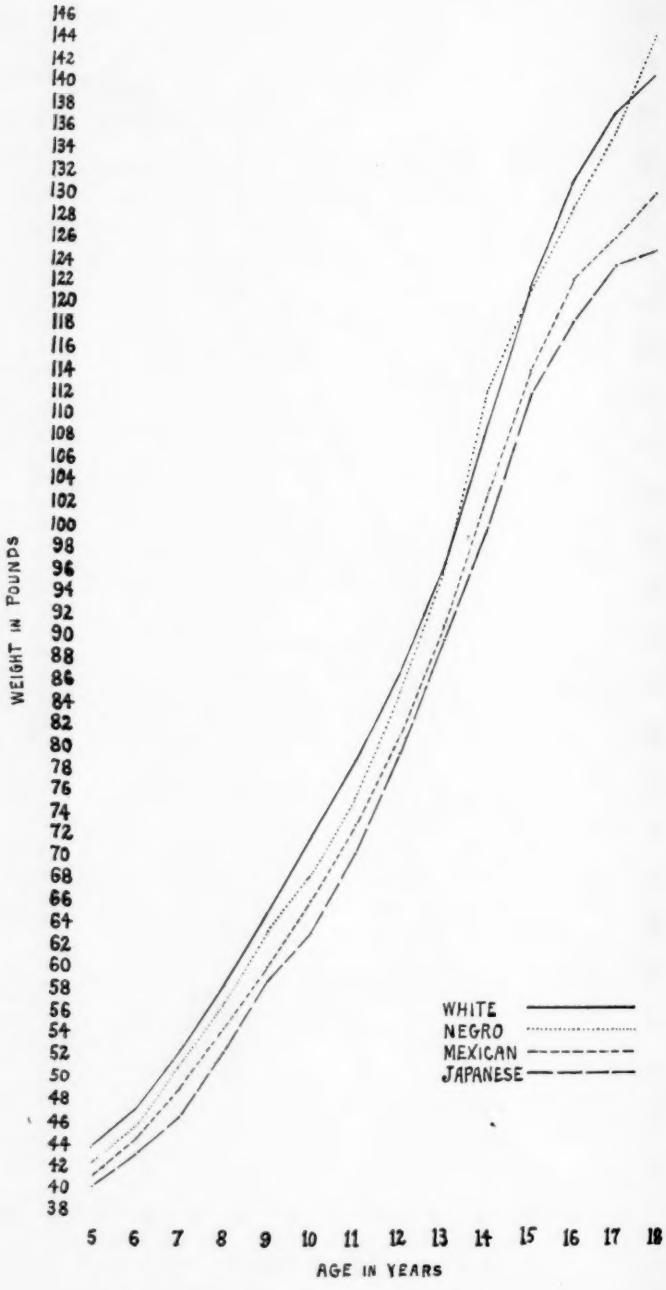

CHART III. Weight for age, boys of four races.

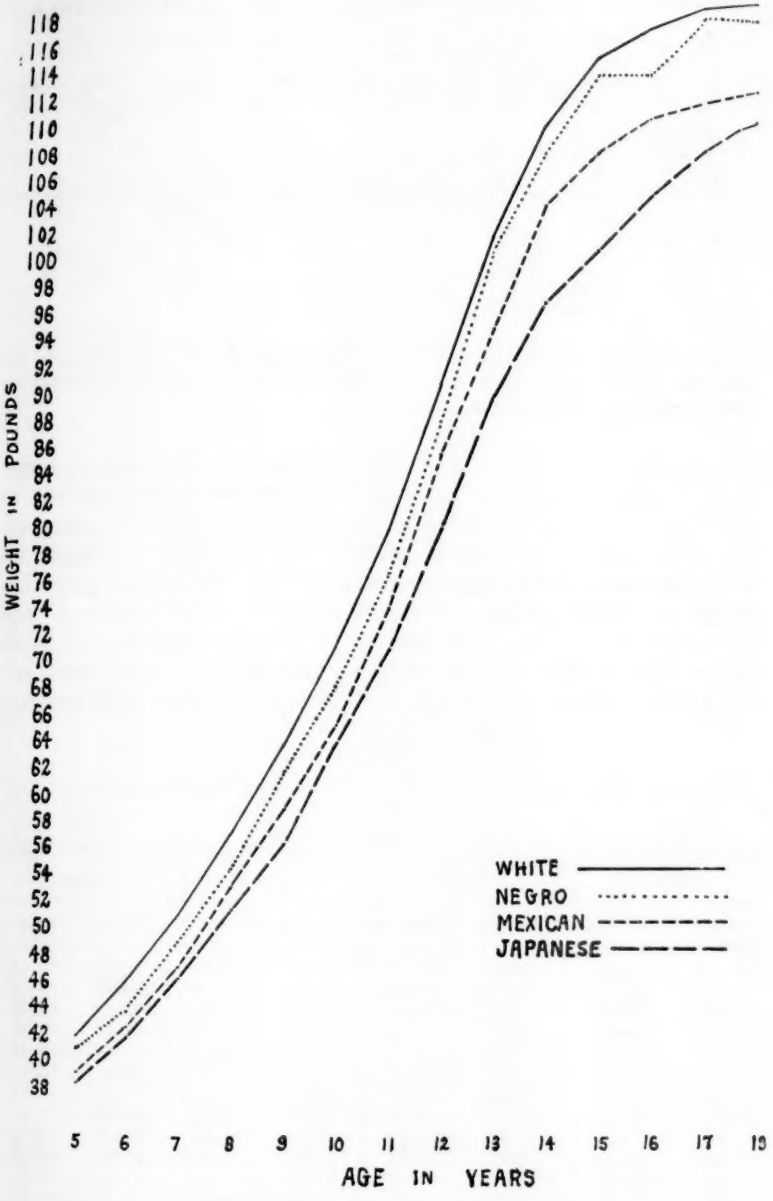

CHART IV. Weight for age, girls of four races.

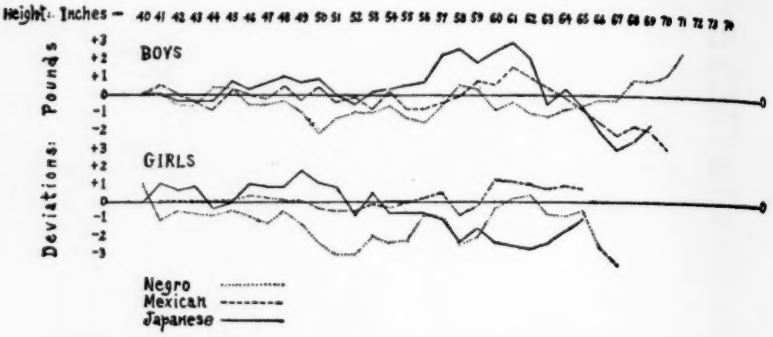

CHART V. Deviations (pounds) in weight per height of Negro, Mexican, and Japanese children from white values based on comparable ages. The straight line (zero) represents white values.

this specific point. Because of this bulkiness and their lack of a more general interest they are not published. By their use, however, we can ascertain the deviations in weight of each race from its corresponding white value at the several heights. This was done and finally the deviations were plotted against a straight base line representing white values, as shown in Chart V. Reading from Chart V, select 58″ girls by way of illustration. Note that at 58″ Mexican girls are 0.7 pounds lighter than whites, Japanese girls 2.3 pounds lighter and Negro girls 2.5 pounds lighter than whites, (all groups 58″ tall). But now note

TABLE III

HEIGHT FOR AGE OF FOUR RACES WITH DEVIATIONS FROM WHITE VALUES—BOYS

(All figures in inches)

White		Negro		Mexican		Japanese	
Age	Height	Height	Deviation	Height	Deviation	Height	Deviation
5	44.17	43.90	−.27	42.91	−1.26	42.25	−1.92
6	46.01	45.54	−.47	44.44	−1.57	43.79	−2.22
7	48.20	47.97	−.23	46.65	−1.55	45.52	−2.68
8	50.40	49.97	−.43	48.82	−1.58	47.73	−2.67
9	52.52	52.35	−.17	50.77	−1.75	50.09	−2.43
10	54.42	53.92	−.50	52.61	−1.81	51.71	−2.71
11	56.30	55.79	−.51	54.63	−1.67	53.57	−2.73
12	58.33	57.83	−.50	56.80	−1.53	55.83	−2.50
13	60.56	60.63	+.07	59.10	−1.46	58.42	−2.14
14	63.25	64.07	+.82	61.63	−1.62	60.67	−2.58
15	65.54	65.70	+.16	63.85	−1.69	63.20	−2.34
16	67.25	66.60	−.65	65.27	−1.98	64.39	−2.86
17	68.08	67.54	−.54	65.77	−2.31	64.80	−3.28
18	68.60	68.52	−.08	66.42	−2.18	65.01	−3.59
Total No. children	61192	2557		11364		1847	

TABLE IV

HEIGHT FOR AGE OF FOUR RACES WITH DEVIATIONS FROM WHITE VALUES—GIRLS

(All figures in inches)

White		Negro		Mexican		Japanese	
Age	Height	Height	Deviation	Height	Deviation	Height	Deviation
5	43.78	43.48	−.30	42.26	−1.52	41.82	−1.96
6	45.66	45.14	−.52	44.09	−1.57	43.45	−2.21
7	47.97	47.70	−.27	46.27	−1.70	45.48	−2.49
8	50.15	50.07	−.08	48.58	−1.57	47.70	−2.45
9	52.14	52.20	+.06	50.60	−1.54	49.40	−2.74
10	54.34	54.12	−.22	52.68	−1.66	51.93	−2.41
11	56.62	56.15	−.47	54.95	−1.67	54.20	−2.42
12	59.15	58.76	− .39	57.39	−1.76	56.62	−2.53
13	61.28	61.15	− .13	59.35	−1.93	58.68	−2.60
14	62.61	62.67	+ .06	60.70	−1.91	59.90	−2.71
15	63.35	63.08	− .27	61.20	−2.15	60.24	−3.11
16	63.66	62.58	−1.08	61.56	−2.10	60.80	−2.86
17	63.78	63.23	− .55	61.42	−2.36	60.65	−3.13
18	63.74	62.74	−1.00	61.45	−2.29	61.01	−2.73
Total No. children	60628	2585		10990		1845	

TABLE V

WEIGHT FOR AGE—FOUR RACES—BOYS: WITH DEVIATIONS FROM WHITE VALUES

(All Figures Weight in Pounds)

White		Negro		Mexican		Japanese	
Age	Weight	Weight	Deviation	Weight	Deviation	Weight	Deviation
5	44.18	42.92	−1.26	41.75	− 2.43	40.68	− 3.50
6	47.93	46.29	−1.64	44.96	− 2.97	43.68	− 4.25
7	52.99	51.94	−1.05	49.53	− 3.46	47.13	− 5.86
8	58.92	57.39	−1.53	55.01	− 3.91	52.94	− 5.98
9	65.64	63.91	−1.73	60.56	− 5.08	59.17	− 6.47
10	72.27	69.03	−3.24	66.61	− 5.66	63.83	− 8.44
11	79.40	76.03	−3.37	73.37	− 6.03	70.95	− 8.45
12	87.32	85.49	−1.83	81.85	− 5.47	80.01	− 7.31
13	96.84	96.72	− .12	91.80	− 5.04	90.13	− 6.71
14	109.78	112.92	+3.14	103.67	− 6.11	100.55	− 9.23
15	122.07	122.15	+ .08	114.80	− 7.27	112.66	− 9.41
16	131.94	129.52	−2.42	122.94	− 9.00	119.20	−12.74
17	138.13	136.48	−1.65	126.87	−11.26	124.44	−13.69
18	141.81	145.34	+3.53	131.11	−10.70	125.90	−15.91
Total No. children	61192	2557		11364		1847	

by referring to Table II that in the case of these 58″ girls the comparison between white and Negro could include only ages 10 to 13 because any lesser or greater age does not give figures for both white and Negro. The white and Mexican comparison at 58″ includes ages 10 to 16, while the white and Japanese comparison includes ages 11 to 16. If we disregard this matter of age coincidence we get the average weight for heights shown in the left-hand columns of Table II, i.e., the Negro 7 pounds lighter than the whites, while the Mexican and Japanese are respectively 2 and 1 pounds heavier, than the whites, but these figures are, as just demonstrated, misleading as a physiological measure of the growth behavior of the races.

By inspection of Chart V very few general trends of racial difference in weight for height can be detected. The most clear-cut and constant deviation from the white is noted among the Negroes, where there is a well-marked tendency throughout for a more slender build than is seen among the whites. This is more noticeable among the girls. In fact, at the tallest statures the Negro boys in our material actually averaged 1 to 2 pounds heavier than did the white. As for the rest, the curves wander above and below the base line of white values in an apparently fortuitous manner. They do not seem to illuminate the subject; in fact more problems are created than are settled by their consideration.

Age-height-weight tables such as here presented, with all their shortcomings, are still widely used in schools, gymnasiums, camps, etc.,

TABLE VI

WEIGHT FOR AGE—FOUR RACES—GIRLS: WITH DEVIATIONS FROM WHITE VALUES

(All Figures Weight in Pounds)

White		Negro		Mexican		Japanese	
Age	Weight	Weight	Deviation	Weight	Deviation	Weight	Deviation
5	42.59	41.59	−1.00	39.79	−2.80	39.00	− 3.59
6	46.61	44.31	−2.30	43.22	−3.39	42.52	− 4.09
7	51.74	49.88	−1.86	47.78	−3.96	46.88	− 4.86
8	57.81	55.13	−2.68	53.73	−4.08	52.01	− 5.80
9	64.12	62.09	−2.03	59.47	−4.65	56.88	− 7.24
10	71.73	68.90	−2.83	65.89	−5.84	64.53	− 7.20
11	80.26	77.18	−3.08	74.79	−5.47	71.75	− 8.51
12	91.27	88.36	−2.91	85.96	−5.31	80.57	−10.70
13	102.23	100.94	−1.29	95.44	−6.79	90.40	−11.83
14	110.31	108.35	−1.96	104.56	−5.75	97.24	−13.07
15	115.75	114.13	−1.62	108.53	−7.22	101.22	−14.53
16	117.83	114.16	−3.67	111.07	−6.76	105.23	−12.60
17	119.23	118.65	− .58	112.19	−7.04	108.62	−10.61
18	119.59	118.37	−1.22	113.00	−6.59	110.84	− 8.75
Total No. children	60628	2585		10990		1845	

as a rough gauge of physical development in children. It is impossible to formulate any general rules by which age-height-weight tables prepared for any single one of these races can be adapted for use among any other race. If they are used among groups of children where various races are represented, tables for each of the races should be available. The present communication provides accurate and contemporaneous material for preparing such tables.

The Status of State Directors of Health and Physical Education

By E. B. Stansbury

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AN ATTEMPT was made in this survey to determine the extent of the administrative setup, the personal qualifications, the duties, and the affiliations of each state director of health and physical education. Considerable emphasis was placed upon the nature of the service bureau, the functions of the field service, and the general requirements for teacher training as they affect the responsibilities of the state directors of health and physical education. Much time and effort were expended in preparing the questionnaire. Many valuable and constructive suggestions were made by outstanding leaders of whom Mr. J. E. Rogers of the National Field Service and Mr. Lewis S. Moorehead, Supervisor of Physical and Health Education of Ohio, are due special acknowledgment.

PROCEDURE

Three form letters, one signed by the Superintendent of Public Instruction of Kentucky, one signed by Mr. Rogers, and one signed by the writer were sent under a single cover to each state director of health and physical education. The two letters mentioned first requested the cooperation of each director in the study; the third letter explained the study, cited the laws and the regulations concerning health and physical education in Kentucky, and requested similar information from the individual states. Under separate cover, a syllabus of physical education for Kentucky which was a published master's thesis from Peabody College [1] was sent to each director. The writer asked for an exchange of syllabi. A 100 per cent response was obtained from all twenty-five states which had state directors.

THE QUESTIONS AND ANSWERS

The questions are given first; the answers follow verbatim in cases where the answers are a unit, but otherwise, a composite answer is given. A short summary follows each major heading except in the case of *D*, where, because of the nature of the questions, a summary follows each question.

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[1] Thomas Herman McDonough, "A Physical Training Manual for Kentucky Schools," master's thesis, George Peabody College, 1928.

A. Details as to Administrative Setup

A-1. *What is your official title?*

Titles	*Directors*
State Supervisor of Health and Physical Education	3
Supervisor of Health and Physical Education	1
Senior Supervisor, Health Education Section	1
State Supervisor of Physical Education and Recreation	1
State Supervisor of Physical Education	1
Supervisor of Physical and Health Education	1
Supervisor, Health Education	1
Director of Health and Physical Education	2
State Director of Physical and Health Education	1
Director for Health, Safety, and Physical Education	1
State Director of Physical Education and Safety Education	1
State Director of Health, Safety, and Physical Education	1
State Director of Physical Education	1
Director of Health, Physical Education, and Recreation	1
Acting Director of Physical Education	1
Chief, Division of Physical and Health Education	1
Chief, Bureau of Health and Physical Education	1
Chief of the Division of Health and Physical Education	1
Director of Program for Improvement of Instruction	1
Advisor of Health, Physical Education	1
State Coordinator of Health, Physical Education and Recreation	1
Teacher Trainer in Physical and Health Education	1

A-2. *Where is your office located?*

Location	*Directors*
State Department of Education	14
State Department of Public Instruction	7
State Department of Public Schools	1
State Board of Education	1
State Board of Health	1
One gave only the city address	1

A-3. *By whom are you appointed?*

Appointers	*Directors*
State Board of Education	9
State Superintendent of Public Instruction	8
State Superintendent and State Board	2
By State Officials after a Civil Service Examination	2
State Superintendent and Director of Instructional Service	1
State Department of Health	1
Governor—	
Recommended by Superintendent of Public Instruction and State Board	1
Recommended by Commissioner of Education	1

A-4. *To whom are you responsible?*

Responsible to	*Directors*
State Superintendent of Education	18
State Board of Education	3

Superintendent of Instruction and State Health Commissioner	2
Superintendent of Public Instruction and Director of Instructional Service	2

A-5. *Do you have an assistant, a co-worker, a secretary, etc.? Tell something of the duties.*

Secretaries	*Directors*
One full-time secretary	17
One part-time secretary	3
Two secretaries (each)	2
No answer to the question	2
No secretary	1

Assistants, Co-workers, etc.	
No indication of assistants	15
One assistant	5
Two assistants (each)	2
Two visual educators and one artist	1
Twenty supervisors and eight stenographers	1
Co-worker (in charge of physical education for girls)	1

It is difficult to determine whether or not the emphasis in each individual state is placed upon the differentials suggested in the individual titles, but more will be said concerning this problem later. It was found that State Supervisor or Director of Health and Physical Education occurred the most frequently. Special attention should be paid to the occurrence of the words "recreation" and "safety" three times each in separate titles. The reader's attention must be called to the offbrand titles which in some measure are suggestive of artificial adoption. In one or two states, individuals who had been doing a full-time job already were persuaded to take the responsibilities of the state directorship.

Twenty-three directors stated specifically that their offices were in or near the state department of education or in the office of the state superintendent of public instruction.

One has only to take a glance at the answers to the question, "By whom are you appointed?" to realize the extreme measures used in appointments. With but three exceptions, the superintendent of public instruction has a significant relationship with the director. In eighteen states the director is responsible only to the superintendent. In four other states, this responsibility is shared with others, and in three states these men are responsible to the state board of education.

From the responses received concerning the assistants, co-workers, secretaries, stenographers, etc., one is compelled to believe that the state directors are very grateful for their help. Many indicated a shortage of help. Assistants and co-workers were listed with such special duties and interests as: (1) giving health instruction, and special and classroom teaching in the promotion of physical education,

(2) conducting special classes in the elementary grades in selected areas for an experimental program, (3) taking charge of physical education, (4) supervising various aspects of the program, and (5) issuing bulletins. One director indicated that he had a co-worker who was in charge of physical education for girls. One state director said that he was looking for a capable woman assistant. An eastern state employs twenty supervisors who supervise various aspects of the program, and eight stenographers who type letters and bulletins, answer inquiries, and mimeograph materials.

B. Personal Qualifications

B-1. *What degree do you hold?*

Undergraduate		*Graduate*	
Degrees	*Directors*	*Degrees*	*Directors*
B.S.	12	Master's	15
A.B.	10	Ph.D.	2
B.P.E.	3	M.D.	2
		Working on a Ph.D.	3
		Working on a master's	1
		M.D. plus a master's	1

B-2. *What are the qualifications for the state directorship in your state?*

Qualifications	*States*
No degree	9
Master's	9
Bachelor's	3
Ph.D. or equivalent (the degree is preferred)	2
M.D. with educational training and experience	1
M.D. or Ph.D. with knowledge in public school administration	1

B-3. *Approximately how many semester hours in health and physical education do you have?*

Semester Hours	*Directors*
0	1
1–10	1
11–20	2
21–30	1
31–40	2
41–50	2
51–60	5
61–70	2
71–80	1
81–90	1
91–100	1
151–160	2
"A major"	2
No answer	2

Range: 0–160, Mean: 59.9

B-4. *What were your undergraduate and graduate majors and minors?*

Subject	*Undergrad.*		*Grad.*	
	Maj.	*Min.*	*Maj.*	*Min.*
Physical Education	13	1	5	2
Physical and Health Education			8	1
Public Health & Physical Education			2	2
Health Education				1
Physiotherapy				1
Safety				1
English	4	3	1	
Education	2	5	5	4
Fine Arts	1			
Engineering	1			
Journalism	1			
Physical Science	1			
Biology	1	1		
Philosophy	1			
Psychology		2		
History		3		
Modern Languages		1		
Sociology		1		1
Science		2		
Mathematics		1		
Speech		1		
Chemistry		1		
School Administration			2	1
Educational Measurements & Statistics			1	
No minor subject		1		7

B-5. *How many years have you been working in the field of health and physical education?*

Years	*Directors*
0	1
1–5	4
6–10	2
11–15	6
16–20	5
21–25	3
26–30	3
"Coaching only"	1

Range: 1–30, Mean: 14.2

One director in the 26–30 group has had four additional years of experience in the field of recreation.

B-6. *What has been your previous experience in health and physical education? (The reader must keep in mind that one director may have had experience in more than one of the following situations.)*

Situations	*Directors*
High school instructor	13
College or university instructor	7
Coaching	7
Director of health education	6
Supervisor of physical education and recreation	5
Recreation	4
Camp work and Y.M.C.A.	4
Director of health education and athletics	1
Athletic officer in the army	1
General school administrator	1
Playground and settlement work	1

The answers to these questions revealed that the directors as a group are professionally minded; however, two made no mention of having done any advanced work beyond the undergraduate degree. These same two individuals failed to indicate the number of semester hours in health and physical education that they have.

One can readily detect that there is a wide range of compulsory qualifications for the directorship of the individual states. One may guess that the older and more established positions (see Table I) have brought with time stricter qualifications, better organization, and a more diversified program.

In the whole group of twenty-five directors, thirteen had an undergraduate major in physical education; three indicated some work in health education. The minor undergraduate fields were considerably scattered. It was found that eight directors chose physical and health education as a major in their graduate work. It is interesting to note that the two directors who have M.D. degrees have acquainted themselves also with the general practices of educational principles.

From the answers that related to the number of years of previous experience that each director had had, one is impressed by the variety of the experiences. It seems that teaching in high school was most significant to thirteen persons prior to their accepting a state directorship. Seven had been instructors either in a college or a university; seven had coached; six had been directors of health education; five had had experience in physical education and recreation; four had had experience in recreation alone, and four had worked in camps and Y.M.C.A.'s Seventy-six per cent of the directors have been working in physical and health education for ten years or more.

C. Office—Salary and Tenure

C-1. *What is your salary range?*

Salary	*Directors*
$2000.–$2999.	4
3000.– 3999.	10
4000.– 4999.	8
5000.– 5999.	1
6000.– 6999.	2

Range: $2000.–$6000.,

Mean: $3500.

TABLE I

States Having Directors Now or in the Past

States	With Directors Now	With Directors Formerly	With Legislation	Date First Director Appointed
Alabama	X		X	1920
Arizona			X	
Arkansas	X		X	1939
California	X		X	1917
Connecticut	X		X	1922
Delaware	X		X	1926
Florida	X		X	1927
Georgia	X		X	1939
Idaho			X	
Illinois	X		X	1929
Indiana	X		X	1932
Iowa			X	
Kentucky		X		1920
Louisiana	X		X	1918
Maine	X		X	1926
Maryland	X		X	1918
Massachusetts	X		X	1922
Michigan			X	
Minnesota	X		X	1923
Mississippi			X	
Missouri	X		X	1923
Nebraska	X			1929
Nevada			X	
New Hampshire			X	
New Jersey	X		X	1918
New York	X		X	1916
North Carolina	X		X	1938
North Dakota			X	
Ohio	X		X	1927
Oregon			X	
Pennsylvania	X		X	1920
Rhode Island			X	
South Carolina	X		X	1939
Tennessee			X	
Texas		X		1930
Utah	X		X	1935
Vermont	X		X	1935
Virginia	X		X	1920
Washington			X	
West Virginia		X	X	1923
Wisconsin			X	

C-2. *What is your office tenure?*

Tenure	*Directors*
No special tenure	12
Indefinite: civil service	2
One year	3
Two years	1
Three years	2
Four years	3
No answer	2

Of those who checked "no special tenure" and of those who failed to answer the question:

One director had held office for 1 year.
One director had held office for 2 years.
One director had held office for 3 years.
Three directors had held office for 4 years.
One director had held office for 5 years.
Two directors had held office for 6 years.
One director had held office for 7 years.
One director had held office for 9 years.
One director had held office for 11 years.
Two directors had held office for 12 years.

One may draw any conclusions he wishes concerning the permanency of the office tenure of the state directors. The questions which come to one's mind as a result of the knowledge gained from these answers are "Who elects or appoints the state board of education and the superintendent of public instruction?" and "How long do they hold office?" One director frankly admitted that his job was subject to the fancies of the state's political machine. In fact, only 50 per cent of the directors indicated a tenure at all, and two of these are under the sheltering wing of the civil service.

D. Duties of the State Director

D-1. *What are your duties in regard to courses of study and syllabi?*

With but three exceptions, the responsibility of preparing, publishing, and supervising the courses of study and syllabi came under the jurisdiction of the state director's office. All three directors who did not have this direct responsibility acted in an advisory capacity to the committee that did have the authority to prepare and publish the courses of study and syllabi. It is not to be interpreted that every state has set courses of study or syllabi which are followed to the last letter. In instances where local situations won't permit such practices, a rigorous course is not followed. There are fifteen states that do not have state directors but that do have prepared syllabi.[2] Two states reported the use of courses of study in safety education.

[2] J. E. Rogers, National Field Service, New York City, 1940.

D-2. *What are your duties in regard to the following*:
a) *Health Service?*

Twenty-two state directors reported that their duties were of a cooperative, advisory, supervisory, promotional, or coordinative nature. According to their various replies, the directors gave full cooperation to all state and local health authorities, helped secure qualified health service for the schools, and made recommendations for a more effective use of health service. In schools where there was no recognized health service, the directors carried on publicity programs in order to awaken local school authorities to the needs of such a service. Two state directors said that they were responsible for the entire health education curriculum in the public schools, and one stated that he had "no health service duties as yet."

b) *Health Instruction?*

Every state director in one way or another helped in the health instruction program. The key expressions used by the directors were rated in order of their frequency. They are (1) promoting and establishing health instruction in schools, (2) preparing and distributing material, courses of study, etc., (3) issuing bulletins, (4) recommending texts, (5) giving advice concerning health instructions, and (6) supervising instruction, a function which was performed by the assistants in one or two of the better established organizations. In some situations, the local supervisors performed this duty, and the state authorities merely advised. Some of the less frequent expressions were "insist on better preparation of the teacher," "provide syllabi," etc. Three directors stated that they had complete charge of all health instruction in the public schools.

c) *Health Supervision?*

The answers to this question related responsibilities similar to those of health service and health instruction. The outstanding duties are (1) suggesting, supervising, and promoting better sanitary school facilities in and around the schools, (2) cooperating with local and state authorities in maintaining acceptable health standards, and (3) preparing and distributing materials and bulletins pertinent to sanitation.

d) *Physical Education?*

The most frequent duties of the directors are (1) to supervise and promote programs, (2) to hold conferences, (3) to prepare news letters and bulletins, (4) to revise courses of study, etc., (5) to give talks to P.T.A.'s and service clubs, (6) to direct demonstrations, and (7) to make personal visits. As was true in the case of health instruction, these duties were considered the responsibility of assistants in physical education wherever assistants were employed.

e) Safety?

The words cooperation, supervision, and promotion are the words that appeared most often in the answers to this question. The directors listed as another pertinent responsibility the preparation, organization, and presentation of safety materials. The impression was left with the writer that in a great majority of the states much effort is being made to integrate safety into every phase of life, particularly as it applies to the school and the home.

f) Athletics?

Ten directors stated that their duties in regard to athletics were of an advisory, supervisory, promotional, or cooperative nature. In one or two states a combination of two of these duties was indicated. Three said they were members of the board of control of the state high school athletic association. Twelve did not answer the question.

f-1) Does your state have an interscholastic association?
Twenty-three answered "Yes," two answered "No."

f-1-a) By virtue of your office, do you have any connection with the state interscholastic athletic association? If so, to what extent?

Ten answered "No." Of the fifteen who answered "Yes," two were members of the central board; three were ex-officio members; two were members of the executive committee; one guided and supervised the interscholastic and intramural athletics; one was the secretary of a committee (made up of superintendents) on physical education and recreation, and one by virtue of his office, was president of the association, but he had a chairman of the central committee to act as executive officer. Five stated that their duties were of an advisory nature only.

f-1-b) Whose complete responsibility is this organization?

Ten directors stated that the state high school athletic association (usually made up of school principals) had the responsibility of this organization. Nine said that it was the responsibility of the principals who controlled the athletic activities through a board of directors. In two states the commissioner of athletics had this responsibility. Two said that it was no one's responsibility, and two did not answer the question.

f-1-c) Is the individual school's interscholastic program your official concern?

Fourteen directors answered "No," six answered "Partially, only as it affects health and physical education." One from this group of six said that the interscholastic program was his concern when the program was held during school hours. Only two directors answered "Yes," and two answered "In an advisory capacity only." One did not answer

the question. The evidence herein presented is very conclusive that the state directors have very little to do legislatively, or otherwise, with the athletics in the state.

D-3. *Do you have any official duties other than those herein mentioned?*

Four said that they were in full cooperation with the health and physical education program, and recreation as it pertains to athletics. Four had temporary assignments at various times, but they didn't say what these were. Three were members of the executive committee; two were supervisors of physical and health education in teacher-training courses, and one was the director of certification. One was assistant high school and elementary supervisor; one was in charge of transportation, and one checked on school reports concerning facilities, programs, and teaching personnel. One was a specialist in the audiometric and sight-testing program in the state by special act of the legislature; one was responsible by law to prepare materials and supervise work in the field of safety education; and one was on the advisory committee for maternal and child health care and a consultant for the P.T.A. Two answered "No" and three did not answer at all.

D-4. *What are your relationships with the teacher-training institutions?*

All the state directors used the words "advise," "supervise," and "cooperate." Eleven specifically used the first two of these words. Two not only advised, but they taught in the summer schools of the teachers colleges. It seems to the writer that the outstanding influence manifest by the directors upon the teacher-training institutions was the constancy in which the directors insisted upon the semester hour requirements for an undergraduate teaching major or minor in their particular states. The tendency was to divide the requirements into three divisions, namely: a major group consisting of usually twenty-six to thirty-six semester hours in health and physical education with certain prescribed courses; a minor group consisting of twelve to eighteen semester hours with certain prescribed courses; and a third group consisting of two to four hours with at least one prescribed course and covering all teachers, but particularly those preparing to teach in the elementary field. These, or similar requirements are fast becoming state laws.

D-5. *Programs and duties in regard to the field.* (*a*) *In what way do you assist the superintendents?*

There are two general answers to this question. About half of the number said that they accompanied the local superintendents for the purpose of addressing groups, holding conferences, teaching demonstration lessons, and helping with exhibits. The other half named as their

duties, in cooperation with the superintendents, the setting up of physical and health education programs, suggesting changes and improvements, issuing bulletins to the teachers, recommending teachers, and preparing courses of study.

b) In what way do you assist the school principals?

The answers to this question were almost identical to and as equally distributed as the answers of (*a*). Often the director met with the principals and the superintendents together. The directors mentioned that if the principals called on them to give a demonstration lesson, they did. Some of them mentioned checking on libraries and equipment with the principals.

c) How do you aid the classroom teacher?

The whole twenty-five mentioned that they did whatever they thought would help the teacher. Such aids were named as: issuing news letters and bulletins, putting other pertinent materials in the possession of the teacher, offering suggestions, teaching classes, conducting sectional meetings of teachers, discussing programs, and making interpretations. Wherever there was a local supervisor of physical education, the supervision generally was left up to the local supervisor.

d) Whose responsibility is the physical education curriculum in the public schools?

Responsibility of	*States*
Local board of education	9
State superintendent	7
Each school administrator with staff	5
Special teacher or teacher trainer	2
State director of physical education	2

It is quite evident from the tabulation that the physical education curriculum is a local responsibility in most cases.

E. Affiliated Relationships

E-1. *What is your connection with the state-wide health association?*

Connection	*Directors*
Cooperative	11
Advisory	3
Member of committee	2
On board of directors	2
Members only	2
No affiliation	1
Secretary of organization	1
No such organization	1

One director said that he was the secretary-treasurer of the association for health, physical education, and recreation, but that the association had

no relation with public health. Another said his connection existed only in the schools, but that he was closely associated with the state department of health by being allowed to attend their meetings.

E-2. *What is your connection with the state-wide safety education program?*

Connection	*Directors*
Cooperative	8
Responsible for work in schools	4
Member of committee on safety education	4
No connection	4
Sit in at conferences	2
Advisory	1
"Do not know."	1
"Very little."	1

E-3. *What is your connection with the state-wide physical education association?*

Connection	*Directors*
Member of executive committee	7
Secretary, or secretary-treasurer	6
Cooperative	4
Advisory	4
Member only	3

One director as state supervisor of high schools tries to see that the state law and the state board of education regulations are carried out.

E-4. *What personal contacts do you deem necessary to further your program?*

With the exception of four who did not answer this question, everyone said it was his duty to make as many contacts as possible, with educational organizations and civic clubs.

E-5. *With what conferences, both in and out the state, do you think it necessary to affiliate?*

With the exception of three who did not answer the question, everyone named practically the same organizations.

State Organizations

State Teachers Organizations
Physical and Health Education Sections of the State Education Association
State Professional Groups
Principals' and Superintendents' Organizations
State Administrators' Organizations
State Safety Council
Public Health Organizations

Out-of-State Organizations

American Association for Health, Physical Education, and Recreation
National Recreation Association
National Education Association
National Association of State Directors of Health and Physical Education
Public Health Organizations

It is apparent that in many of these functions, the state director performed only in a cooperative and an advisory capacity. In most instances the state health associations are instruments of the state department of health, and many times the state department of health seems to be primarily concerned with the individual county health units and their operations. In the answers to these questions, the word "cooperation" appeared many times. This was particularly true in the connections with the state-wide health association and with the state-wide safety education program. When we look into the state physical education association, we find a different story. Thirteen directors held executive offices in the association, and four served as advisors. Every-one of these individuals who answered this question stated that he affiliated himself with at least one state and one national organization.

F. Service Bureau

F-1. (*a*) *Do you have an information filing system?*

Filing Systems	*Directors*
"Yes"	15
Beginnings of one	3
A limited one	3
"No"	2
No answer	2

b) To what extent does it function?

Extent of Function	*Directors*
No answer	9
Fairly well	7
For office use only (to answer request letters)	4
Keep on file all pertinent materials	3
Send bulletins to local authorities who in turn pass on the information	1
For clipping service	1

F-2. *Is your job to furnish up-to-date material (pamphlets, mimeographed bulletins, etc.), to the classroom teacher?*

Responsibility	*Directors*
"Yes"	14
Through the superintendent	5
"No" (One of these said that it wasn't his duty, but he did it; one said that circular letters were sent out periodically.)	3
"Sometimes."	1
"It will be."	1
"I have just begun."	1

Apparently, most of the directors are making an attempt to take advantage of the service bureau as a means of distributing materials.

G. Field Service of All Kinds

G-1. *What are your duties when you are traveling over the state?*

These answers were practically the same as those that listed the duties of the directors in relation to the superintendents, principals, and teachers. Conferences with state and local teacher groups, students, doctors, dentists, and nurses, were listed as important contact services.

G-2. *Who pays your traveling expenses?*

It was found that the state paid the expenses for all directors. The expenses of one came from a superintendent of public instruction fund.

G-3. *What provisions are made for your transportation?*

Provisions	*Directors*
Personal car with five cents a mile for mileage	9
Allowed traveling expenses by bus or train	4
Budget	4
State car	3
Mileage, hotel, and means	2
Personal car with four cents a mile for mileage	2
Mileage (not indicated how much)	1

G-4. *How much money are you allowed for yearly traveling expenses?*

Expenses	*Directors*	*Expenses*	*Directors*
$ 420.	1	$ 800.	2
500.	1	900.	1
500.–600.	1	1000.	5
600.	1	1100.	1
600.–700.	1	1200.	3
700.	1	1500.	2
		No set sum	4

One state allows from $9,000 to $12,000 for entire division of health and physical education.

In a field of service of this kind, it is evident that much traveling from place to place must be done. In 44 per cent of the states a mileage guarantee was given and the director used his personal car, but in four states the director traveled by train or bus. Whenever the occasion permitted, the superintendent and the director traveled together. Eighty-four per cent of the states stipulated the sum that the director might spend yearly for transportation.

SUMMARY AND CONCLUSIONS

1. Twenty-five states, representing 75 per cent of the schools' population, have state syllabi and state directors of health and physical education.

2. Thirty-eight states have legislation concerning physical education, and 40 states have prepared syllabi.

3. The greatest number of appointments of state directors came in the decade from 1920 to 1930.

4. There are three states that formerly had state directors, but that do not have directors now.

5. The "one" preferred title is State Supervisor or Director of Health and Physical Education, or Physical and Health Education.

6. The director's office is located near the superintendent of public instruction's office, and the director is responsible to the superintendent in 88 per cent of the cases.

7. The assistants and co-workers are found in numbers according to the population and the general economic condition of the individual states.

8. Thirty-six per cent of the states have no degree requirement for the state directorship.

9. Fifty-two per cent of the states require a master's degree or better for one to qualify for the state directorship.

10. The mean semester hours in health and physical education of the directors is 59.9.

11. A major in physical education appears more regularly on the undergraduate level of the directors than it does on the graduate level.

12. The mean years of experience in health and physical education is 14.2. The range is from 1 to 30 years.

13. Fifty-two per cent of the state directors have had experience as high school instructors.

14. The range in yearly salary is from $2000 to $6000. The mean salary is $3500.

15. Forty-eight per cent of the directors have no office tenure.

16. The directors' duties concerning health service, health instruction, health supervision, and physical education are similar, especially as to supervision, demonstration, personal visits, issuing bulletins, preparing and revising courses of study, etc.

17. The state directors have very little to do with the state athletic associations.

18. In most cases, the directors are concerned with interscholastic athletics only as it affects health and physical education.

19. The directors "advise," "supervise," and "cooperate" in their relations with the teacher-training institutions.

20. The majority of the directors make an attempt to get the most good out of the service bureaus.

21. Eighty-four per cent of the states stipulate the sum that the directors spend yearly for transportation.

22. In forty-four per cent of the states, a mileage guarantee is given, and the director travels in his personal car.

23. Evidence indicates that political influences interfere with the best efficiency in carrying out the work of the state directors of health and physical education.

24. At the present time only two states require an open competitive civil service examination before appointments to the state directorships can be made.

As a suggested procedure for the final selection of the state director, the writer makes the following recommendations based upon the findings of this study: (1) a master's degree in physical or health education; (2) an open competitive civil service examination; (3) appointment to be made by a representative committee consisting of six persons with the superintendent of public instruction as chairman. The other members should be made up of one faculty member from the teacher-training institutions of the state, one appointed by the county superintendents of the state to represent the rural areas, one appointed by the city superintendents of the state to represent the urban areas, one chosen by the public school teachers, and one chosen by the state department of health. The members of the committee could be chosen at the state educational meeting, and they would serve for a period of three years without pay. Their tenure of office could be so arranged that no two members would go out of office at the same time. The functions of the committee would be to coordinate all the factors which are pertinent to health, physical education, recreation, and safety. This committee, working through the superintendent of public instruction, would aid the director in every possible way to perform a better service to the state.

The Present Status of Strength Testing for Children of Elementary School and Preschool Age

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During the last twenty years much has been written about strength testing as applied to the physical education program. But the lion's share of this literature has dealt with the use of strength tests in the high schools and colleges. Some attention has been given to strength testing in the junior high schools, but strength testing in the elementary schools has been largely neglected by research workers in physical education. It is the purpose of this review to bring together the work that has been done on testing the strength of children during the first ten years of life, to point out the problems involved in such testing, and to evaluate the contributions which have been made. To the extent that the review accomplishes this purpose, it should constitute a foundation for future research in this area.

In limiting the review to material dealing with children ten years of age and younger, a second limitation imposes itself. With very few exceptions, strength testing at this age level, particularly in the school situation, has been restricted to grip strength. Consequently, this survey and evaluation of the literature dealing with strength tests for children in the first decade of life is, in the main, a discussion of grip strength testing.

THE INSTRUMENTS

There are three types of dynamometers in general use in school testing programs: the elliptical Collin type dynamometer, the rectangular manuometer, and the Smedley type dynamometer with an adjustable handle.

As early as 1897, Binet and Vaschide [7]* demonstrated that the size of the handle of the dynamometer was a factor in determining the record made. Using two elliptical dynamometers, one 12.5 cm. by 5.0 cm. and one 9.5 cm. by 3.8 cm., they tested 45 boys ranging in age from ten to fourteen years. They found that for those boys whose hands were less than 14.0 cm. in length the best scores were made on the small dynamometer; for those whose hands were more than 16.5 cm. the best scores were made on the large dynamometer; and for those whose hands were between 14.0 and 16.5 cm. there was little difference in the scores made on the two instruments.

* Superior figures refer to numbered Bibliography at end of article.

In 1900, Smedley[33] reported a similar experience with the manuometer, stating:

> An attempt to test the young children with this instrument proved that it was entirely unsuited to the size of their hands. Those with the smallest hands were forced to use a different set of phalanges from those which the adult would use on the same instrument. Again it was found that the adult could make his best record only when the instrument was suited to the size of his hand. (p. 59–60)

This experience led him to devise the now familiar Smedley dynamometer with the adjustable handle. Subsequent experimenters, however, have reported some difficulty in using this instrument with children in the lower grades. Dewey, Child, and Ruml[12] wrote concerning its use with children eight to thirteen years of age:

> The size of the dynanometer [*sic*], which is made for the adult hand, makes the test unfair to some subjects. The bars of the grip are so broad and thick that the smaller children cannot get a very firm hold and so are probably considerably handicapped in their performance. (p. 64)

Johnson,[22] who attempted to measure the grip strength of children from three to thirteen years of age, stated:

> The instrument is unsatisfactory for small children. The breadth and thickness of the bars prevent the smaller children from getting a firm hold and probably cause a discomfort which handicaps the performance in succeeding trials. (p. 40)

Metheny,[28] working with preschool age children, reported the use of a smaller dynamometer, patterned after Smedley's but having a smaller handle. The instrument is light in weight (.34 kg.) and carries a spring which permits accurate calibration from 1 to 22 kg. The instrument was constructed and is recommended for use with children from two to seven years of age.

Blackhurst [8] devised an apparatus consisting of a set of weights and pulleys, which she used to measure the strength of preschool children. Yarmolenko [35] used a suspended football filled with sand for measuring the strength of a blow with the arm. This, combined with the distance the subject could jump and the heaviest weight he could carry, was considered to give a good measure of the strength of the child. The Martin [25] resistance dynamometer has been used for testing the muscle strength of children who have suffered from poliomyelitis, but the nature of the test makes it impractical for routine use in school testing.

MOTIVATION

As has been pointed out by many investigators, the grip strength score depends principally upon two factors: (1) the actual muscular strength of the individual, and (2) the degree to which he exerts that strength in performing the test. Perhaps the most difficult problem faced in strength testing is that of insuring maximum effort on the part of

the subject; and with younger children who have less understanding of the nature and purpose of the test, the problem of motivation may become acute.

Chase [10] studied the effect of various types of motivation on the performance of 213 children, three to eight years of age, on a special dynamometer which permitted the experimenter to control the apparent result of each "squeeze" and, at the same time, secure a record of the actual result. She found that "success" on a trial produced better scores on succeeding trials, and there appeared to be a tendency for praise and reward following success to further increase the scores. Anderson and Smith [1] repeated these experiments on the same children after a three year interval and obtained similar results.

Jersild,[21] who tested 46 children between the ages of four and six, felt that rather extreme motivation procedures were necessary. He wrote:

> The experimenter entered into the project with appropriate abandon; cheer-leader tactics while the child was squeezing the instrument, congratulations, handshakes, and applause when a past record was attained, and other devices gave the project much of the flavor of an athletic event. (p. 26)

On the small dynamometer described by Metheny,[28] a motivating device is attached to the circular dial. This consists of a superimposed dial carrying the picture of "Dyna, the Hungry Duck," so arranged that when the child grips the dynamometer the duck rotates, creating the illusion of eating the grains of corn which are visible through an opening in the top dial. The number of grains which the duck eats varies with the strength of the grip.

EFFECT OF PRACTICE

Jersild [21] studied the effect of practice on grip strength by using two matched groups of 23 children each, four to six years old. After four initial trials were given both groups, the experimental group was given 43 practice sessions over an 11-week period. At the end of this time the practice group was significantly superior to the control group, but this superiority disappeared during the following three months when neither group practiced the test. He attempted a similar experiment testing the strength of the back with the Sargent back and leg dynamometer, using matched groups of 16 children each, two to four years old. His results were not reliable, and he commented: "The children in the present experiment showed somewhat less interest than the children who were given practice with the hand dynamometer." (p.45)

RELIABILITY OF THE TEST

Jersild, for the groups described above, determined the degree of consistency between the best score made in the first two initial trials and the best score made in the third and fourth trials. For the practice

group the product moment correlation was .82 and for the control group .90. Johnson [22] reported a test-retest correlation coefficient of .83 from grip strength data for 57 subjects, three to thirteen years old. When chronological age was held constant, this correlation fell to .68. Metheny [28] computed reliabilities of the grip strength using hand-sex subgroups within one year age intervals from three to six years. From the results of six days of testing, three trials each day, she compared the highest score made on the even days with the highest score made on the odd days. For groups ranging in size from 19 to 42 subjects, these correlations were .90 or better, with but one exception. For the combined age groups, right hand, the correlations were .96 for boys and .95 for girls.

VARIABILITY

For girls, Baldwin [4] found that the coefficient of variation decreased from 30.3 at seven years to 12.7 at seventeen years. For boys the coefficient of variation was 30.2 at seven years, fell to 16.1 at eleven years, rose slightly at fourteen and fifteen, falling again to 17.2 at seventeen years. Meredith [27] found a similar trend for boys from three to eighteen years of age. He reported that the highest coefficient of variation was found at three years, 34.5, decreasing to 17.6 at ten years, rising slightly from ten to twelve, and then decreasing to 16.6 at eighteen years. Metheny [28] reported an average coefficient of variation of 15.1 for boys and girls from three to six years of age, with no marked age or sex differences.

AGE MEANS FOR GRIP STRENGTH

Grip strength averages for children of elementary school age have been reported by numerous investigators. These data have been obtained under varying conditions and on several types of subjects. A summary of the data on which the principal studies have been based is shown in Table I. The studies are arranged chronologically with reference to date of publication.

In Tables II and III the average grip strength for each age covered by these investigations is given. (The means for the ages eleven to eighteen are also included.) An attempt has been made to arrange the averages in order of magnitude. Since the order is not always the same at every year of age, the values reported at ten years for boys have been selected as the point of reference. Direct comparison of the values given is difficult. This follows since some values represent the average of three trials, some the result of one trial, some the best of three trials, some the right hand only, some the best hand, and some the average of the right and left hands. Moreover, in some studies age was taken to the last birthday and in others to the nearest birthday, making a difference of six months in the mid-point of the yearly intervals. Where specific information is reported as to the instrument used, the number of trials given, the way in which the score for each child was determined,

TABLE I

DESCRIPTION OF PRINCIPAL STUDIES GIVING AGE MEANS FOR GRIP STRENGTH OF CHILDREN OF SCHOOL AGE

Investigator	Date	Boys	Girls	Boys and Girls	Age in Years	Description of Subjects
Porter [30]	1892	16,295	18,059		6 to 17	St. Louis public school
Carman [9]	1899	756	751		10 to 18	Saginaw, Mich. public school
Christopher [11]	1900	605	603		4 to 18	Chicago public school
Smedley [33]	1901	2,788	3,471		4 to 18	Chicago public school
Hastings [17]	1902	6,711	6,442		5 to 18	Nebraska public school
Mead [26]	1916	251	249		6 to 18	Caldwell, N. J. public school
Dewey, Child, and Ruml [12]	1920	50 at each age	50 at each age		9 to 13	New York City public school (Jewish)
Baldwin [4]	1921	60 at each age	60 at each age		7 to 17	New York City private school
Arthur [2]	1924	?			6 to 81	English (Galton's original data)
Baldwin [5]	1925	300	270		7 to 17	California "geniuses"
Johnson [22]	1925			262	4 to 13	New York private school
Reed [31]	1926	259			11 to 17	Morgantown, W. Va. public school
Schwarz, Britten, Thompson [32]	1928	2,162			3 to 60	New York public schools
Heinlein [18]	1929			60	4 to 12	New York public schools
Meredith [27]	1935	4,999			3 to 18	Iowa City private school
Metheny (unpublished)	1939		4,787		3 to 18	Iowa City private school
Metheny [28]	1941	116	94		3 to 6	Iowa City private school

TABLE II

AGE MEANS FOR GRIP STRENGTH OF BOYS OF SCHOOL AGE (in kg.)

Investigator	Age in Years 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Instrument	Trials	Typical Age Interval
Schwarz, Britten, Thompson			7.3	7.7	9.2	10.2	11.8	12.7	14.3	16.1	18.6	22.4	27.2	33.0	39.4	39.2	Collin	Best of 3	9–0 to 9–11
Porter				6.1	7.7	9.4	11.4	12.8	14.4	16.7	19.1	22.3	26.7	31.0			?	One (?)	?
Arthur				7.4	8.8	10.4	11.9	13.5	15.1	17.0	19.2	22.1	26.4	30.8	33.8	35.2	?	?	9–0 to 9–11
Hastings			4.9	7.0	9.2	10.6	13.1	14.1	18.0	19.7	22.6	25.4	28.9	33.3	43.2	46.2	Manuometer	2 or 3	?
Johnson*		5.8	6.3	8.1	9.5	11.4	13.7	14.5	15.8	15.8	19.5						Smedley	Average of 3	9–0 to 9–5 9–6 to 9–11
Heinlein†		6.8	7.8	9.1	10.7	12.0	12.8	14.9	16.2	18.9	22.9						Smedley	Average of 3	9–0 to 9–11
Carman								16.0	19.0	21.0	22.0	26.0	30.0	35.0	40.0	42.0	Collin	?	?
Christopher		5.0	6.5	9.0	10.0	12.0	13.0	16.0	18.0	22.0	27.0	30.0	36.0	45.0			Collin	Repeated	9–0 to 9–11
Smedley‡		5.5	7.8	9.2	10.7	12.4	14.3	16.5	18.9	21.2	24.4	28.4	33.4	39.4	44.7	49.3	Smedley	Repeated	9–0 to 9–11
Dewey, Child, Ruml							15.5	16.7	21.2	23.2	25.9						Smedley	3 trials Average R and L	9–0 to 9–11
Mead				8.6	10.4	13.1	15.7	18.1	21.1	24.5	26.5	31.3	40.2	50.4	53.1	52.7	Manuometer	?	?
Reed									19.7	22.2	24.8	28.2	30.2	32.6	35.8		Manuometer	Average R and L	?
Baldwin (1925)					13.7	13.7	18.2	19.5	22.0	24.2	26.7	31.8	37.9				Smedley	?	?
Baldwin (1921)					12.6	14.8	17.7	19.8	21.8	23.8	27.7	30.3	35.0	41.7	45.3		Smedley	?	8–9 to 9–3
Meredith§	5.1	7.6	10.2	11.4	13.0	15.8	17.9	20.3	22.5	25.0	29.2	33.9	38.9	44.8	48.3	52.4	Smedley	2 with best hand	8–6 to 9–5
Metheny	7.9	9.5	11.7	13.1													Modified Smedley	3 trials 6 days best hand	3–6 to 4–5

*Boys and girls combined.
†Boys and girls combined, reported in half-year intervals.
‡"Birthday Norms" adjusted to make mid-point of age interval exactly 7-6, 8-6, etc.
§Mean at three years obtained over age range 3-0 to 3-5. Means at four and five years reported in half-year intervals. Succeeding means represent age in even years.

TABLE III

AGE MEANS FOR GRIP STRENGTH OF GIRLS OF SCHOOL AGE (in kg.)

Investigator	Age in Years 3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Instrument	Trials	Typical Age Interval
Porter				5.1	6.5	8.1	9.2	10.4	11.8	13.5	16.1	18.0	20.0	21.8	21.9		?	One (?)	?
Hastings			4.7	5.2	7.5	9.3	10.1	13.0	14.1	16.0	18.5	21.7	24.4	24.1	24.1	25.3	Manuometer	2 or 3	?
Carman								11.0	13.0	15.0	18.0	20.0	21.0	21.0	23.0	24.0	Collin	?	?
Christopher		4.0	7.0	7.5	9.0	10.0	12.0	12.5	16.0	19.0	22.0	24.0	27.0	32.8			Collin	Repeated	9–0 to 9–11
Smedley*		5.6	7.2	8.4	9.9	11.2	12.8	14.7	16.5	18.9	21.8	24.8	27.0	28.7	29.6	29.8	Smedley	Repeated	9–0 to 9–11
Dewey, Child, Ruml							14.0	15.1	17.5	19.8	24.0						Smedley	3 trials Average	9–0 to 9–11
Mead				7.6	8.0	9.7	12.1	14.1	17.3	22.9	24.3	29.6	32.0	33.5	32.1	33.3	Manuometer	R and L	?
Baldwin (1925)					10.4	12.6	15.4	16.1	19.8	21.2	26.0	28.0	31.9				Smedley	?	?
Baldwin (1921)					11.2	13.2	15.9	18.5	20.0	22.0	25.2	28.1	30.4	32.3	32.2		Smedley	?	8–9 to 9–3
Metheny† (1939) ..	4.3	6.4	8.4	9.2	10.7	12.5	14.6	16.5	19.1	21.7	26.0	28.5	30.6	31.4	32.2	33.1	Smedley	2 trials best hand	8–6 to 9–5
Metheny (1941) ...	6.8	8.9	10.1	11.3													Modified Smedley	3 trials 6 days best hand	3–6 to 4–5

* "Birthday Norms" adjusted to make the mid-point of each age interval exactly 7-6, 8-6, etc.

† Mean at three years obtained over range 3-0 to 3-5. Succeeding means represent age in even years.

and the specific limits of the age intervals used, this is indicated. A question mark in any column indicates that the author failed to discuss this aspect of his investigation.

Taking the values given for ten-year-old boys as representative, the means may be grouped as: Low—Schwarz, Britten, and Thompson; Porter; Arthur; Hastings; Carman; Christopher; Smedley. Intermediate—Reed; Mead; Dewey, Child, and Ruml. High—Baldwin (1921 and 1925), Meredith; Metheny (1939 and 1941). Heinlein and Johnson are omitted from comparison since the two sexes are combined in their studies.

With the exception of the Schwarz, Britten, and Thompson study, all the low values were obtained prior to 1902. Arthur did not publish until 1924, but his data were obtained by Galton in the nineteenth century. All the low values were obtained on public school children, and those given by Carman, Christopher, and Schwarz, Britten, and Thompson were obtained using the Collin type elliptical dynamometer.

The intermediate values given by Reed, Mead, and in Dewey, Child, and Ruml were obtained during the years 1916 to 1926 on public school children with either the Smedley dynamometer or the manuometer. Jewish subjects were used by Dewey, Child, and Ruml.

The high values given by Baldwin, Meredith, and Metheny were all obtained during the last two decades on private school children, with the Smedley type dynamometer.

In general, it would seem that the highest means have three common factors: they are the most recent chronologically, they were obtained on private school children, and the Smedley type dynamometer was used. It is not possible from the available studies to determine the relative importance of the socio-economic factor (as indicated by private school attendance) and the several other factors (e.g. geographical, climatological, etc.) possibly involved.

The values given in Tables II and III, and the foregoing discussion of them, make it evident that at present no "norms" for grip strength of elementary school children may be said to exist. They serve to emphasize the fact that the grip strength of any child or group of children should not be compared with existing means for grip strength unless care is taken to ascertain that the comparison is justifiable, i. e., that both series of data may reasonably be regarded as samples of the same population.

GROWTH IN GRIP STRENGTH

Meredith [27] reported that boys increased in grip strength 359 per cent from six to eighteen years of age. For girls, Metheny [28] found the comparable figure to be 260 per cent. Metheny also reported that during the preschool years, from three to six, both boys and girls increased about 65 per cent in grip strength. The "mean course of growth" for grip strength for boys was described by Meredith as:

. . . a relatively slow and constant growth below twelve years, a period of rapid increase between twelve and sixteen years, and a phase above sixteen years indicating a decline in growth rate. (27, p. 39)

According to Smedley:[33]

The curve representing the strength of the boy's left hand runs nearly parallel to the curve representing his growth in weight, and in the earlier years of adolescence the curve representing the strength of the right hand gradually approaches the curve of weight. With the girls the lines representing strength and weight gradually become farther and farther apart. (p. 60)

Baldwin [4] analyzed the individual curves of growth in grip strength for a number of children of elementary school age. He found "marked fluctuations," which he attributed to the "element of voluntary effort." (p. 80) He stated:

. . . there is more overlapping, with marked fluctuations in increments of improvement or regression in individual strength curves than is the case in curves of height, weight, breathing capacity, sitting height and chest girth. . . . Development in strength of right arm, left arm, and upper back is materially affected by prolonged disease history. (p. 94)

ANTHROPOMETRIC RELATIONSHIPS

Baldwin,[4,5] Johnson,[22] Gates,[14] and Metheny [28] have reported on the relationship of grip strength to certain anthropometric measurements.

Baldwin [4] studied approximately sixty children of each sex at each age from seven to seventeen years. His subjects were drawn from the Horace Mann School of New York City. He computed correlations of grip strength with height, weight, and breathing capacity for each age-sex group, and obtained all the possible combinations of first-order partial correlations for the same variables. His results show a wide range of correlation values from group to group for any given combination of variables. This makes it difficult to draw conclusions, but in general it may be said that for boys the relationship between grip strength and weight is closer than that between strength and height. For girls, the reverse appears to be true. Baldwin [5] also reported correlations between grip strength, breathing capacity, and chronological age for a group of California "genius" children ranging in age from seven to fifteen years.

The private school children tested by Johnson [22] were from three to thirteen years of age. For both sexes combined, grip strength correlated .68 with the weight/height index, but this was reduced to .37 when age was held constant. Gates [14] studied the measurements of 58 junior primary pupils (average age, 5.7) and 57 pupils in fourth grade (average age, 9.6). He computed correlations specific for the four age-sex groups, but reported only the average of these correlations as follows: grip strength with height .45, with weight .40, with lung capacity .46, with chest girth .36, with ossified carpal area .25, and with heart rate -.06.

Metheny [28] studied the relationship of grip strength to age, height, chest circumference, elbow width, shoulder width, sitting height, hip width, weight, upper arm girth, forearm girth, arm length, trunk length, surface area, and breathing capacity for 110 boys and 79 girls between the ages of two years six months and six years five months. The subjects were drawn from the preschool laboratories of the Iowa Child Welfare Research Station. Correlations of .75 or higher were found between grip strength and height, breathing capacity, arm length, shoulder width, sitting height, weight, and age for both sexes. However, when height was held constant through partial correlation, all of the correlations became too small to be significant. Multiple correlations between grip strength and various combinations of anthropometric variables were only slightly higher than the simple correlation of grip strength and height. For boys, age and height correlated .82 with grip strength; for girls, .86. Tables for estimating the grip strength of an individual from his age and height were presented, these tables being applicable to children between the ages of two years six months and six years five months. It was suggested that these tables be used to determine the Grip Quotient: the actual grip strength multiplied by 100 and divided by the expected grip strength.

COMPARATIVE STRENGTH OF RIGHT AND LEFT HANDS

Heinlein [18] tested the grip strength of 60 children, four to twelve years of age, over a period of five years. She found that 61.7 per cent were consistently "right-handed" in all tests, 3.3 per cent were consistently "left-handed," and 35.0 per cent were inconsistent. From data on children three to thirteen years of age Johnson [22] concluded:

> There are few young children who show consistent superiority of one hand in consecutive trials, and in annual retests in the dynamometer test. There is a marked tendency toward ambidexterity or right-handedness with increasing chronological age. (p. 77)

Mead [26] compared 430 children, six to eighteen years of age, in the public schools of Caldwell, New Jersey, with 430 children in the Indiana School for Feeble-Minded Youth. He found a difference in the means in favor of the right hand at all ages for normal children, but for the feeble-minded the strength of the two hands was more nearly alike and at some ages the left was stronger than the right. This is in accord with Smedley's statement concerning Chicago public school children:

> . . . on the whole, the brightest are more decidedly unidextrous than are the dull pupils, and they in turn are more decidedly unidextrous than are the pupils of the John Worthy School. (33, p. 91)

Woo and Pearson [34] analyzed 7000 records of grip strength taken from the files of Sir Francis Galton. They reported:

> Absolute grip of the stronger hand rises from about 11.6 lbs. at 6.5 years of age to about 84 lbs. at 32 years, and falls to 56 lbs. at 79 years. But the

differences of right-handed and left-handed grips remain about 3.6 lbs. through all age groups. (p. 168)

Metheny[28] found that the percentage of cases for whom the right hand was stronger increased from 42.5 per cent at three years to 80.0 per cent at five and six years. At five and six years, about 10 per cent of the children showed no difference between the two hands, while for another 10 per cent the left hand was stronger than the right. Although the absolute difference in strength between the two hands increased with age, the difference remained roughly proportional to the mean strength of the stronger hand. Of 32 children retested after an interval of eight months, 20 were consistent with their first scores, 8 showed a shift towards the right hand, and 4 showed a shift toward the left hand.

MENTAL RELATIONSHIPS

Many attempts have been made to relate physical ability to mental ability, the variety of results obtained being almost as great as the number of persons working on the problem. Excellent reviews of studies in this area have appeared from time to time,* so discussion here is limited to a mere listing of the studies dealing with grip strength of children of "normal" mentality, and a rough summary of the findings.

A positive relationship between strength of grip and some measure of mental ability has been reported by: Porter,[30] Binet and Vaschide,[7] Carman,[9] Christopher,[11] Smedley,[33] Garrison and Pullias,[13] Berry and Porteus,[6] Hollingworth and Taylor, [20] Monahan and Hollingworth,[29] Gates,[14] Baldwin,[15] and Hoefer and Hardy.[19] In none of these studies is the relationship marked, and in many of them the findings appear questionable. A lack of relationship has been reported by: MacDonald,[24] Kiefer,[23] Johnson,[22] Gilbert,[14,15] and Metheny.[28] Evidence of a low negative relationship was presented by Bagley.[3] From these studies it is impossible to draw any precise inference as to the true relationship existing between grip strength and measures of mental ability. Considering all the evidence it may be tentatively concluded that the correlation is either very slightly positive or zero.

SEX DIFFERENCES

The existence of a sex difference in strength of grip has been implied by every investigator who has reported separate values for boys and girls. Specific statements concerning this difference may be of interest. Smedley,[33] who studied children in the Chicago public schools, wrote:

> . . . the boys surpass the girls in strength at all ages; even in the kindergarten the average boy is stronger in his left hand than the average girl is in her right hand, and during the early years of adolescence this differentiation of the sexes becomes very striking. (p. 60)

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* Harold E. Jones. "Relationships in Physical and Mental Development," *Review of Educational Research*, 3 (1933) 150–162; 6 (1936) 102–123; 9 (1939) 91–102.
Donald G. Paterson, *Physique and Intellect*. (New York: The Century Company, 1930) pp. 304.

Baldwin [4] stated:

> Girls are inferior to boys in all strength tests, girls showing, after 15 years of age, little increase and frequently a decrease in strength. (p. 94)

Johnson [22] reported a similar finding for the ages three to thirteen years. Metheny [28] found that the mean grip strength of boys exceeded that of girls at each year from three to six. However, the boys were also somewhat taller than the girls. Since the relationship between height and strength is positive, the method of analysis of covariance was used to "adjust" the grip strength means for these differences in height. When height was thus taken into account, the differences in mean strength for boys and girls were not statistically significant at three years or at four years; at five years of age the difference was significant at the 5 per cent level, and at six years it was significant at the 1 per cent level.

MOTOR ABILITY

In the course of an investigation of the motor ability of children in the first three school grades, Carpenter [36] tested the grip strength of 128 boys and 125 girls. She reported correlations of .38 for boys and .24 for girls between grip strength and a battery of five tests designed to measure motor educability.

HEALTH RELATIONSHIPS

The relationship of grip strength to health status of the individual has received scant attention in the literature. Gates [14] correlated the grip strength of junior primary and fourth-grade pupils with ratings of "physical vigor" made by five teachers. The average correlation was .31. When nutritional status (weight minus weight given in the Baldwin-Wood tables) was added, the multiple correlations averaged .45. Correlating "physical vigor" with grip strength, weight, lung capacity, chest girth, height, and Carter's ossification ratio increased the coefficient to .61. Gates concluded:

> The degree of ossification of the carpal bones, measures of nutrition, weight, height, grip, or any other single physical trait is mildly indicative of the general physical efficiency status, but when all of these are properly combined, they yield a significant measure. (p. 561)

Metheny [28] classified 81 preschool children (ages two years six months to six years five months) on the basis of Grip Quotients obtained in the fall at the beginning of the school year, and 69 children on the basis of Grip Quotients obtained in the spring. For both groups, those children who had high quotients were absent for illness a significantly smaller percentage of the time than those who had low quotients. No differences for the Grip Quotient groups were found in health ratings made by the school nurses and fatigue ratings made by the preschool teachers. The tetrachoric correlations between Grip Quotient (above or

below the mean) and percentage of time absent for illness (above or below the mean for the age group) was -.42 for the fall cases and -.51 for the spring subjects. Concerning the distributions shown in these tetrachoric correlations, the author commented:

> . . . it would seem that while a high grip quotient is a reasonably good indication that a child will not have an excessive amount of absence during the school year, it cannot be said that a low grip quotient indicates that he will be absent frequently. One possible interpretation of this finding would be that while a high grip quotient is evidence that a child is as strong as his record indicates, a low grip quotient may be partially the result of inadequate motivation, malingering, or lack of interest. (p. 177–178)

Metheny also studied the relationship of daily grip strength and breathing capacity test scores to the occurrence of colds. She tested 22 children daily from November 15 to December 15 and from January 3 to February 23. Using as the criterion score the difference between the record made on any given day and the average of the records made on the two preceding days, she analyzed such differences with relation to the occurrence of colds. It was found that on the basis of "drops" in grip strength and breathing capacity, colds could be "predicted" with a fair degree of success from one to three days before they became manifest. Tetrachoric correlations between positive and negative predictions and occurrence or non-occurrence of colds ran from .62 to .81 for the several combinations of criteria used with the November-December data, and from .54 to .69 for the January-February data. Concerning these results Metheny commented:

> It is not the purpose of this paper to suggest that the tests actually measure the presence of an infection of the upper respiratory tract. It is more likely that they measure a general fatigued condition. When such a condition is present, the child is probably more susceptible to infection. Since the present investigation was made during a time when colds and influenza were prevalent in the community, it may well be that the percentage of children developing colds following fatigue was much greater than it would be during a different period of the year. (28, p. 197)

SUMMARY

From this review of the literature dealing with the grip strength of children during the first ten years of life, it is evident that while many investigators have worked in the area, few of the studies have been productive of results that are clearly of practical significance to the physical education teacher. The studies do show, however, that the test of grip strength may be administered successfully to children in the elementary school and preschool, and there are indications that the test might be a useful one for the physical education teacher. The review also points out some of the pitfalls of such testing, and offers suggestions as to how these may be avoided.

In future testing, either for service or research purposes, the following points appear pertinent:

1. The instrument must be suited to the size of the child's hand. Either the Smedley dynamometer or some modification of it will probably be the most satisfactory.

2. The child must be given sufficient experience with the test so that he understands what is expected of him, and care must be taken to motivate him to exert all the force of which he is capable.

3. There is at present no set of age means for grip strength which may be considered as "norms." Comparison of scores should probably be made only within the group being tested until it is possible to accumulate sufficient scores to establish averages and zones of individual variation for the specific child population in question.

4. The relationship of grip strength to gross bodily size is so close that the size of the individual must be taken into account in evaluating any grip strength record.

5. The existence of a sex difference in grip strength during the elementary school years has been sufficiently well established to make it evident that scores for boys and girls may not be combined either for research or clinical evaluation.

6. Since a significant number of children will exhibit greater strength with the left than with the right hand, both hands should be tested and the score of the stronger hand used.

7. There seems to be little reason to expect to find any very high degree of relationship between grip strength and measures of mental ability.

8. While evidence concerning the relationship of grip strength to health status of the individual is scant, there is some indication that this may be a fruitful field for research.

9. The relationship of grip strength to measures of motor ability at the elementary school level is a relatively unexplored topic.

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Present Practices and Methods of Supervising Practice Teachers in Physical Education

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THE problem in this study involves three phases of student teaching: (1) to determine the present practices of the programs in which student teaching is done; (2) to analyze the significant variations, and to illustrate important central tendencies in the technique of supervising student teachers; (3) to propose an adequate means of evaluating student teachers in physical education.

THE PURPOSE

This study grew out of the fact that the writer is primarily concerned with the supervision of student teachers in physical education. Since the interest of the writer lies in attempting to aid the present program for teacher training in physical education, it was natural to investigate the practices and methods as utilized in other institutions with the ultimate purpose of improving the present program for student teachers at the University of Kentucky.[1]

THE PROCEDURE

Questionnaires in the form of check lists, appropriate for this study, were mailed to 120 institutions of higher learning. These were sent to three types of institutions: (1) state teachers colleges, (2) state universities, and (3) privately endowed colleges. Of this group 64 institutions returned the questionnaires with the requested information. Of this number there were 34 from state universities, 22 from state teach-

[1] In regard to the problem covered by this study, Mr. M. E. Potter, Head of the Department of Physical Education, University of Kentucky, writes: "The problem of an adequate and efficient program in directed or practice teaching for physical education undergraduates assumes major proportions for many teacher-training administrators and critic teachers. The duties and responsibilities of the secondary school teacher of physical education are numerous and varied. How may the year or semester allotted to practice teaching be best utilized? Will it amount to 'just another' physical education course or will it be a time for 'real directed teaching' conducted on an educationally sound basis in a school environment which is typical of the one in which the neophyte is soon to find himself as a full-fledged teacher?

"There is a need, therefore, for a study to answer some of the problems involved. The 'rating scales' formulated from this particular study are offered as a practical aid for both critic teacher and student. Their use is intended to raise the level of efficiency and effectiveness of directed teaching in physical education."

ers colleges, 7 from privately endowed colleges, and one from a territorial school.

THE RESULTS—PART I
PREVAILING PRACTICES AND REQUIREMENTS

From the beginning of state supported institutions to the present date, student teaching has been regarded as an indispensable part of teacher training. With a constant increase of training and laboratory schools, student teaching in the major subject is indubitably necessary to the success of the individual as a prospective teacher. Since student teaching is to some extent an outgrowth of institutional necessities and certification requirements, it is found that many variations exist among the general practices and requirements.

1. (*a*) Student teaching was offered in schools according to the following rank order: (1) city school systems, (2) laboratory or training schools, (3) college physical education departments, (4) county school systems, (5) recreational or community centers, (6) parochial schools.

b) Student teachers are placed in situations of the following rank order: (1) physical education classes, (2) intramural activities, (3) free play periods, (4) coaching duties, (5) field days and club activities.

c) Student teachers are placed in the grade levels of the following rank order: (1) secondary schools (9th grade to 12th grade), (2) elementary schools (4th grade to 8th grade), (3) college level.

2. (*a*) It was found that supervisors of student teachers are fairly well qualified for their work because of their educational background. They rank in the following order: (1) 65 per cent have the master's degree, (2) 18 per cent have the doctor's degree, (3) 16 per cent have only the bachelor's degree.

b) From the above it was found that the mean number of teaching years in physical education is 12 years, and that the mode of teaching is from 1 to 7 years.

c) Likewise from the above it was found that the mean number of years in supervising experience is 8 years and that the mode of experience is 1 to 3 years.

3. (*a*) The requirement for teacher certification varied, ranging from 1 to 10 semester credit hours per year. The 6 semester credit hour requirement per year is most widely used.

b) In certification according to quarter credits, the range varied from 2 to 6 quarter credits. It was found that 4 and 5 credits were given in most cases.

4. (*a*) As to the year that student teaching is offered, it was found that the senior year is most widely used. However, there were instances where the graduate year (4), the junior year (2), and the sophomore year (1), are likewise used.

b) The length of the course in which students participated varied from 12 to 36 weeks. The number of weeks most widely employed is 36.

5. (*a*) It was found that all schools used the "observation" method in conducting student teaching, and that one-third of the entire time is consumed in observing physical education classes.

b) Little time, if any, is spent in the observation of classes other than physical education.

c) To the question of how long do student teachers observe prior to their actual attempt at teaching, it was found that 90 per cent of the schools require their students to observe from one to three weeks before they are given their teaching assignment.

d) As to the number of individual conferences held by the critic teachers with student teachers, a range of 1 to 8 conferences a week was found. Of this group 53.8 per cent of supervisors replied to one conference a week.

e) As to the number of group conferences held by the supervisors, a range of 1 to 8 conferences a month was found. Of this group 62.1 per cent of the supervisors held one group conference a week.

6. (*a*) As to method courses used in physical education as prerequisites to student teaching, the following are in rank order for 70 per cent to 16 per cent of responses:

1. Introductory Athletic Coaching.
2. Organization and Administration of Physical Education.
3. Group Games (Low Organization).
4. Curriculum and Methods of Physical Education.
5. Remedial Physical Education.
6. Recreational Administration.
7. Health Education.
8. Gymnastics in Physical Education.
9. Physical Education in the Secondary Schools.
10. Principles of Physical Education.
11. History of Physical Education.
12. Tests and Measurements in Physical Education.
13. First Aid and Athletic Training.

RESULTS—PART II

SIGNIFICANT VARIATIONS AND IMPORTANT CENTRAL TENDENCIES

1. *The Present Practices Concerning Observations.*—

a) Of the supervisors, 85.5 per cent state that student teachers observe them while they are teaching.

b) 91.6 per cent of the supervisors discuss observations in conferences.

c) Supervisors disagree as to the presentation of observation outlines to student teachers for guiding purposes; 29.7 per cent issue these outlines whereas 60.3 per cent do not.

d) Supervisors disagree as to allowing student teachers to observe one another; 66.1 per cent prescribe this practice whereas 33.9 per cent do not.

2. *The Present Practices Concerning Conferences.*—

a) Supervisors disagree as to discussing all teaching faults with student teachers in conferences; 60.3 per cent discuss all faults whereas 39.7 per cent do not.

b) Supervisors disagree as to discussing faults with student teachers in the first conference; 37 per cent of supervisors discuss teaching faults at this time whereas 62.5 per cent do not.

c) Supervisors disagree on whether or not conferences should be held following a regular class period; 61.7 per cent hold conferences at this time whereas 39.2 per cent do not.

d) Supervisors disagree as to arranging conferences according to a prearranged schedule; 66.7 per cent of the supervisors have such a schedule whereas 33.3 per cent do not.

e) Supervisors likewise disagree as to holding individual conferences only when deemed necessary; 45.5 per cent hold these conferences only in case of necessity whereas 54.5 per cent do not.

f) Supervisors agree to the following:

(1) Most of the supervisors, 94.3 per cent, discuss a few teaching faults at a time with their student teachers.

(2) All agreed that good points as well as bad ones should be mentioned to the student teachers in these conferences.

(3) Group conferences according to a prearranged schedule are held by 90 per cent of the supervisors.

3. *The Use of the Course of Study and Lesson Plans.*—

a) Supervisors disagree on requiring the student teachers to formulate a course of study; 35 per cent stipulate this whereas 65 per cent do not.

b) Supervisors disagree as to allowing the student teachers to make their own selection as to a unit, 59.3 per cent allow the students to make the selection whereas 40.7 per cent do not.

c) Supervisors disagree as to requiring the student teachers to formulate units for teaching from those that already have been formulated by the critic teacher of supervisors; 68.3 per cent of the supervisors stipulate that units formed by the student teachers be based upon their own whereas 31.7 per cent allow the students to formulate an original one.

d) Supervisors are in agreement on the following:

(1) Student teachers are required to formulate teaching units by 87.9 per cent of the supervisors.

(2) Daily lesson plans are required by 87.1 per cent of the supervisors.

(3) Lesson plans must be approved by 93.5 per cent of the supervisors before they may be used by the student teachers.

e) Supervisors vary as to the number of days in advance that teaching units be presented for approval before usage. (1) None to 2 days, 42 per cent; (2) 3 to 5 days, 28 per cent; (3) 6 to 8 days, 30 per cent. The mean was found to be 3.8 days in advance, while the mode was none to 2 days.

4. *The Responsibilities of Student Teachers.*—Under responsibilities of student teachers, it was found that the supervisors disagree to all of the questions asked in this phase of the study, which means that there is no set criteria for the responsibilities that student teachers are to perform while they are in training.

a) To the question, "Do the students have full responsibility in the management of class problems?" 68.3 per cent replied yes, 31.7 per cent no.

b) To the question, "Is the selection of physical activities left to the judgment of the student teachers?" 43.3 per cent replied in the affirmative, 56.7 per cent replied in the negative.

c) To the question, "Are student teachers allowed any administrative responsibilities?" (making out requisitions, orders, inventories, clerical work, etc.), 32.2 per cent responded in the affirmative, 67.8 per cent in the negative.

d) To the question, "Are student teachers responsible for reports on professional readings?" 71.2 per cent replied in the affirmative, 28.8 per cent replied in the negative.

e) To the question, "Are all student teachers required to refer class problems to the critic teacher or supervisor?" 43.3 per cent replied in the affirmative and 56.7 per cent in the negative. In the latter group about 10 per cent stipulated this responsibility only to the extent of the severity of the problems that arise.

5. *The Time the Critic Teacher or Supervisor is in the Classroom with the Student Teacher.*—

a) Approximately 87 per cent of the supervisors or critic teachers visit the student teachers at frequent intervals. The remaining 13 per cent limit their visits either to the beginning or to the latter part of the period.

b) Critic teachers or supervisors spent an average of 75 per cent of their time with the student teaching. The mode of visits was found to be 100 per cent of the time with student teachers. The range of time in per cent was 30 to 100.

RESULTS—PART III

1. *A Means of Evaluating Student Teachers in Physical Education.*—In attempting to find definite criteria by which one may rate

student teachers, it was first necessary to find the methods used in rating. The check list gave the following results to the questions asked:

a) To the question, "Do you use a definite objective method in rating your student teachers?" 32 per cent replied in the affirmative while 68 per cent replied in the negative.

b) To the question, "Is a rating scale used for grading the student teachers?" 30 per cent replied in the affirmative while 70 per cent replied in the negative.

c) To the question, "Is the final rating of your student teachers based upon your subjective judgment?" 75.5 per cent replied in the affirmative while 24.5 per cent replied in the negative.

d) To the question, "Do you use a final semester examination as a basis for determining a final rating?" 8.2 per cent replied in the affirmative while 91.8 per cent replied in the negative.

The above results eliminated the final examination method. However, it left the writer without a solution. The writer wonders whether the rating scale is a trend toward evaluation, or if the complete subjective method may be accepted because of the results obtained? In order to eliminate any doubt, the criteria and results for each were submitted and received. The bases for evaluation of student teachers in physical education found thus are shown in Table I.

TABLE I
CRITERIA FOR EVALUATING STUDENT TEACHERS

Criteria for Evaluation	Per Cent Yes	Per Cent No
Classroom management	91.9	8.1
Leadership ability	91.9	8.1
Teaching technique	90.3	9.7
Personal equipment	88.7	11.3
Scholarship	88.7	11.3
Professional attitude	87.1	12.9

The writer tends to disagree with those supervisors who endorse solely the self-subjective method. Because of the results obtained, the writer is in sympathy with those supervisors who use the rating-scale objective method. Subjectivity cannot be avoided, for all rating scales are made up of subjective opinions. However, this subjectiveness is directly controlled by recognized criteria that can be used in the measurement of the abilities of the student teachers.

Because of the complete agreement of supervisors on the criteria that student teachers are rated on, this criteria was used as the basis of the evaluation scale to be used by the critic teachers and supervisors, and of the self-rating scale to be used by the students. In the pages following, the two types of scales are made up of the recognized criteria. Each quality has been broken down into as many sub-qualities as possible.

To defend the rating scale, the writer feels it best to add that the

evaluation scale may be used for the following: (1) as a basis of rating student teachers, (2) as a means of providing school boards, superintendents, or supervisors with a true testimonial of the ability of student teachers, (3) as a permanent record in the office of the supervisor, and (4) as a means of aiding the students in their work. The self-rating scale of the student teacher is to be used primarily as a stimulus to better himself as a teacher through self-criticism and self-analysis. His own rating should be compared with that of the supervisor or the critic teacher so that the necessary adjustments can be made.

EVALUATION OF THE STUDENT TEACHER

Student Teacher ..... Score ..... Grade ....
Activity ..... Class ..... Date .....
Number of days of teaching .....
Number of periods absent .....
Number of times tardy .....
Number of students in class .....

Instructions: In rating a quality of a student teacher one must bear in mind the following scale: Students' grades are based on letters, A (superior), B (above average), C (average), D (below average), and E (inferior). For each letter value a numerical value should be indicated. The numerical value indicated will to some extent illustrate a truer value of the student involved. The numerical values are the following: A (21 to 25), B (16 to 20), C (11 to 15), D (6 to 10), and E (5 and lower).

Each alphabetical rating is broken into five digits, this being used to see where that individual falls in his alphabetical rating. After rating has been completed, an average of the sum of each quality will give the critic teacher and supervisor a better idea as to the ability of the student teacher.

Note: Indicate in the proper column the numerical value of the student teacher.	Superior	Above Average	Average	Below Average	Inferior
1. *Personal Equipment:*					
a) Personal appearance					
b) Reliability					
c) Enthusiasm					
d) Industry and initiative					
e) Sense of humor					
f) Command of English					
g) Proper uniform					
h) Tact					
2. *Professional Attitude:*					
a) Interest toward work					
b) Interest toward pupils					
c) Ability to understand criticism					
d) Punctuality					
e) Professional interest and growth (readings, lectures, exhibits, and professional meetings)					
f) Cooperation with colleagues, faculty, and parents					
3. *Scholarship:*					
a) Knowledge of subject matter					
b) Attention to individual differences					
c) Selection and use of functional objectives					

	Superior	Above Average	Average	Below Average	Inferior
d) Knowledge of and interest in current events					
e) Knowledge of the current affairs in the field					
4. *Classroom Management:*					
a) Prompt and effective solution of emergencies					
b) Availability of materials					
c) Attention to such matters as light, heat, and ventilation					
d) Care of the gymnasium and the equipment					
e) Disciplinary measures					
f) Ability to economize time and effort					
g) Ability of organization in crowded situations					
5. *Leadership Ability:*					
a) Ability to arouse pupil interest and initiative toward activities					
b) Contributions to proper growth of the children (character and morals)					
c) Willingness to assume responsibilities					
d) Creating learning situations					
e) General culture and refinement					
f) Loyalty to superiors					
g) Wholesome social outlook					
6. *Teaching Techniques:*					
a) Care in the selection of subject matter					
b) Skill in preparation					
c) Personal ability in the gymnasium, sports, and recreation					
d) Questioning and testing					
e) Skill in illustrating and explaining					
f) Ability to get results					
g) Control over students					
h) Attention to records and clerical details					

Other comments that may be used in evaluating the student teacher:

SELF-RATING SCALE OF STUDENT TEACHERS IN PHYSICAL EDUCATION

Student Teacher ..... Score ..... Grade ....
Activity ..... Class ..... Date .....

Note: In the proper column place a numerical value of what you believe is an accurate rating of yourself.

	Superior	Above Average	Average	Below Average	Inferior
1. *Personal Equipment:*					
a) Is my posture the type that one should strive for					
b) Do I dress neatly					
c) Do I keep myself well groomed					
d) To what extent am I reliable in my work					
e) Do I show enthusiasm in my work					
f) Do I do my work willingly					
g) Am I capable of taking a joke					
h) Do the students understand the English I use					
i) Is my voice clear					
j) Is my diction mature					
Average the total sum					
2. *Professional Attitude:*					
a) To what extent am I interested in my work					
b) Does my interest lie with the pupils					

c) Can I take it, if I am criticized by a superior .....
d) Do I take advantage of corrective criticism .....
e) Do I get to class on time .....
f) Is teaching the profession for which I am best fitted ..
g) Do I indulge in any professional periodical readings...
h) Do I attend lectures in physical education or education
i) Do I cooperate with other student teachers .....
j) Do I cooperate with members of the faculty .....
k) Do I cooperate with the parents .....
Average the total sum .....

3. *Scholarship:*
a) Have I a good background for my profession .....
b) Am I acquainted with the rules of all sports .....
c) Am I acquainted with the works of prominent men in the field .....
d) Can I distinguish individual differences .....
e) Am I a good judge of objectives for activities .....
f) Am I acquainted with the objectives of physical education .....
g) Do I teach so as to meet the objectives .....
h) Am I acquainted with the events of our government..
i) Am I acquainted with the events of foreign affairs ....
j) Do I know the present trends of the field .....
Average the total sum .....

4. *Classroom Management:*
a) Can I solve problems effectively .....
b) Am I prompt in solving problems .....
c) Do I use the available materials .....
d) Am I conscious of the lighting effect in the gymnasium
e) Am I conscious of the temperature of the gymnasium..
f) Am I conscious of the cleanliness of the gymnasium....
g) Am I conscious of the amount of ventilation in the gymnasium .....
h) Do I see to it that the gymnasium is treated with proper care .....
i) Am I acquainted with all pieces of equipment used in the gymnasium .....
j) Do I see to it that proper care is given to the equipment
k) Am I aware of the disciplinary measures that may be taken in a gymnasium .....
l) Am I punctual in attendance .....
m) Do I begin class at the scheduled time .....
n) Are the materials to be used for class purposes on hand before class begins .....
o) Am I conscious of a crowded gymnasium .....
p) Do I see to it that at some time or other during a crowded gymnasium that everyone has had something to do .....
q) Do I direct "horse play" toward a better end .....
Average the total sum .....

5. *Leadership Ability:*
a) Am I able to arouse the interests of pupils .....
b) Am I able to arouse interest toward initiativeness ....
c) Do I make a good example of character .....
d) Do I make a good example of morals .....
e) Am I a good influence on the pupils .....
f) Do I accept responsibility willingly .....
g) Am I able to take a situation from the pupils and create so that a definite learning takes place .....
h) Am I loyal to my superiors .....

i) Do I have faith in them					
Average the total sum					
6. *Teaching Technique:*					
a) Do I know the subject matter					
b) Do I examine myself before I select the subject matter					
c) Am I acquainted with the general objectives of the subject matter					
d) Am I acquainted with formulating teaching units					
e) Are my lesson plans directed toward the objectives ...					
f) Do I examine myself as to my knowledge of the lesson plans					
h) Are my questions understood by all					
i) Do I examine myself as to the clarity of the questions..					
j) Am I acquainted with the procedures of testing					
k) Do my tests measure what they propose to measure...					
l) Are my demonstrations done clearly					
m) Are my explanations clear and uniform					
n) Does my technique of demonstration and explanation bring proper control					
o) Do I have proper control of the pupils					
p) Must I resort to disciplinary measures in order to gain proper control					
q) Do I take the attendance daily					
r) Are excuses from class recorded and filed					
Average the total sum					

CONCLUSIONS

This study found that the procedures of supervising student teachers in physical education vary to some extent. The greatest variations, however, lie not in the practices, but in the methods employed by supervisors in carrying out their programs.

The writer believes that this disagreement as to methods results from the absence of definite criteria by which supervisors may conduct their programs of directed teaching. Student teaching in physical education has been accepted by many institutions of higher learning, which leads one to believe that this phase of the student teacher's professional training is an indispensable part of his preparation as a teacher of physical education. As a result of this study the following recommendations for improvement in student teaching are offered:

1. Require the course of directed teaching to extend over a period of one school year.

2. Require at least one-third of the total time of the student teachers for observations of physical education classes, community center, and playgrounds.

3. Present outlines to student teachers so that a definite and organized observation can be made.

4. Require student teachers to formulate teaching units and lesson plans.

5. Establish definite criteria for the evaluation of student teachers.

6. Establish definite responsibilities for student teachers so that these responsibilities will serve as experiences derived from directed teaching.

The Application of the State Regulations Governing the Boys' Physical Education Laboratory Program in Thirty-five Centralized Schools of New York

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During the past thirty years the administration of interscholastic, intramural, and recreational activities in the public schools has become increasingly important. Considerable controversy has been evident through the years as to the method of control best suited to these activities. In September of 1938, a complete set of state regulations was put into effect governing these phases of physical education in all schools in New York.

These regulations were presented to the schools during 1937, and there was immediate discussion throughout the state as to whether or not such regulations were desirable or fair to the schools involved. Resulting controversy has continued in a general way from 1937 until the present time, but recently various phases of the regulations have become more and more the target of attack from newspapers, coaches, physical educators, and others interested in athletics and physical education.

Specific regulations which have been attacked most vigorously are those governing interscholastic participation and the requirement of a weekly minimum of 300 minutes of supervised physical activity for each student in the secondary school grades.

PURPOSE OF THE STUDY

Centralized schools have constituted a major development in the educational program of many states during the past ten years, and moneys have been appropriated quite extensively for the provision of gymnasiums, playgrounds, and other facilities vital to the conduct of satisfactory programs of physical education. This study was conducted to determine whether or not centralized schools in New York have adopted the new regulations for use, and are conducting physical education programs for boys in accordance with them. The specific phases included in this study were as follows:

1. To determine the extent to which the regulations governing the

This article is an abstract of a master's thesis, Syracuse University, 1940.

laboratory program[1] for boys have been put into effect in centralized schools since their adoption in September, 1938.

2. To determine the difficulties encountered by administrators and physical educators in centralized schools in applying the regulations.

3. To determine the opinions of physical educators in centralized schools as to the advisability and practicability of the regulations.

LIMITATIONS OF THE STUDY

The programs and procedures in physical education have become so varied that this study was limited to a consideration of the three phases of the laboratory program—interscholastic, intramural, and recreational physical activities as they apply to boys in centralized schools from grades seven through twelve. By such limitation it was felt that a thorough investigation of the laboratory portion of the program could be carried out more effectively and that specific applications to the state regulations governing these phases could be made.

Visitation was limited to 35 centralized schools in the belief that this constituted an adequate sampling of these schools in New York. The schools visited ranged in size of boy-enrollment in grades seven through twelve from 50 to 375, and included a sampling of small schools in strictly rural areas, large schools in strictly rural areas, small schools adjacent to large cities, large schools in suburban communities, and village centralizations.

METHODS OF INVESTIGATION

The methods employed in conducting this study were as follows:

1. The literature in the field was studied to determine: (*a*) state regulation of physical education in the United States; (*b*) legal provision for physical education in New York; (*c*) development of regulations specifically adopted by the Board of Regents for New York; (*d*) development of interscholastic athletic regulation in New York; (*e*) development of the present state regulations.

2. An interview outline was prepared, designed to include the varied aspects and problems involved in the laboratory program in physical education. The outline was criticized by physical education staff members at Syracuse University, tested with the cooperation of physical educators in three centralized schools, and on the basis of criticism and pertinency of replies was adapted for use.

3. Thirty-five centralized schools were visited, and the physical educator was interviewed in each school. The schools visited were classified as to size according to the boy population in grades seven

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[1] "Laboratory program" includes the practice and play periods—club activities, intramural and interscholastic games and sports, and organized recreational activities conducted outside the regular class periods.

through twelve. Three divisions were made and the schools, as thus designated, were:

Class A: Over 200 boys—6 schools
Class B: 100 to 199 boys—14 schools
Class C: Under 100 boys—15 schools

4. The offices of the State Division of Health and Physical Education in Albany were visited for the purpose of examining the school records for 1938–39 in order to determine relative facts as indicated by the annual reports submitted by the schools. A summary of each school's report as it applied to this study was made.

5. Material gathered from the interviews was analyzed and tabulated.

6. Finally, the data were prepared with the present State regulations as a basis for interpretation, and the findings were summarized.

DEVELOPMENT OF THE PRESENT NEW YORK STATE REGULATIONS

In 1934, a research committee was formed by the New York State Public High School Athletic Association to work with the State Division of Health and Physical Education and the Research Division of the State. The material collected by the combined committee was compiled and analyzed by Dr. Warren W. Coxe, Director of the Educational Research Division of the State, and his staff. Results were reported late in 1934 and the committee was continued and further reports were made in 1935.

The data thus found served to convince school authorities that changes were necessary in the administration of school athletics. Other professional groups were studying the problem at the same time. Included among these groups were: a committee of the State Health and Physical Education Association; executive committees of the New York State Athletic Leagues; and national groups who were recommending and urging changes. Data from all sources were compiled and evidence secured to point the direction that the program should take.

NEED FOR REGULATION

It was becoming more and more apparent that the New York State Public High School Athletic Association and other state associations lacked sufficient authority and power to govern athletic activities for the state as a whole. Minimum regulations that would safe-guard the health of the participants and guarantee management of athletic activities on an educational basis seemed urgent.

The New York State Public High School Athletic Association initiated, sponsored, and financed a Joint Committee on State Athletics to investigate and recommend procedures. Organizations represented on this committee were; Associated Academic Principals, New York State Council of Superintendents, Association of School Board Trustees, New York State Division of Health and Physical Education, Central

Committee of the State Athletic Association, Public School Athletic Leagues of Buffalo and of New York City, and the Eastern New York League.

In December, 1935, this committee passed a resolution recommending that a joint committee be organized to formulate a minimum code of regulations to govern interschool athletics. This committee was active for two years and its attention was directed toward drafting regulations which might be presented to the groups represented for approval and modification, before being presented to the Commissioner of Education and the Board of Regents for their approval. The Board of Regents accepted the Regulations on July 30, 1937, with the provision that they were to become effective in September, 1938.

SUMMARY OF FINDINGS*

1. *The Program.*—

"All schools under the jurisdiction of the State Education Department shall provide a program of health and physical education in an environment conducive to healthful living."

All the schools studied provided a program of health and physical education. Twenty-four of these schools arranged special periods for pupils participating in the laboratory phases of the program.

a) All schools provided interscholastic and recreational programs supervised by physical education teachers.

b) All but one school sponsored intramural programs under the supervision of physical educators.

2. *Personnel.*—

"It shall be the duty of trustees and boards of education: To provide approved and adequate personnel . . ."

Physical education personnel in all schools was approved and certificated in accordance with the Regulations of the Commissioner and the Board of Regents. Faculty members other than physical education personnel were used extensively to augment the laboratory phases of the program.

a) All coaching of athletic teams was done by individuals holding a New York teaching certificate.

b) The interscholastic program was organized and controlled in all schools by the physical education staff. .

c) Physical education staffs were fairly adequate. Forty-eight per cent of the schools studied had added to the staff since the regulations were adopted in 1938.

* A brief statement of basic regulation is quoted for each summary from the Regulations or the Statement of Policy Pursuant to the Regulations. (See Bibliography at end of article.)

3. *Activities.*—

"Adequate personnel refers to a sufficient staff to conduct an approved program. This involves . . . procedures that will guarantee a variety of activities rather than a limited interscholastic program."

A varied program of activities was presented in all schools studied.

a) The average number of activities presented in intramural and recreational phases of the physical education program was 20.5 for all schools.

b) A total of eleven different varsity sports were maintained among the 35 schools studied. An average of four varsity sports and one junior varsity sport were offered annually by each school.

4. *Facilities.*—

"It shall be the duty of trustees and boards of education: To provide approved and adequate . . . facilities."

A check of facilities revealed that all but one of the schools had gymnasiums. All the schools had play fields adjacent to the school buildings.

a) In the laboratory aspects of the program, 30 of the schools used indoor facilities not originally planned for physical activities, such as stages, corridors, classrooms, and shops.

b) Twenty-six of the 35 play fields were spacious, well graded, and well equipped.

c) Very few schools took advantage of community facilities to add to the laboratory program.

5. *Records.*—

"It shall be the duty of trustees and boards of education: . . . To maintain for each child cumulative records covering the essential features of the health and physical education program."

All but 2 of the 35 schools met the state requirement in regard to maintaining cumulative records of pupil participation in physical education activities.

6. *Reports.*—

"It shall be the duty of trustees and boards of education: . . . To make reports to the Department on forms prescribed by the Commissioner."

Annual reports to the State Division of Health and Physical Education were made by 31 of the schools studied.

7. *Student Leadership.*—

"Sufficient opportunity for the exercise of pupil initiative, leadership, and responsibility under guidance shall be provided throughout the administration of the program in the secondary schools."

Opportunities were provided for the exercise of pupil initiative, leadership, and responsibility in all but two schools through the use of students as:

a) Assistants in the conduct of the intramural and recreational programs.

b) Managers and captains of varsity sport teams.

c) Scorers, timers, officials, and members of intramural legislative councils.

8. *Time Requirement.*—

"In the secondary schools, a minimum of 5 clock hours (300 minutes) a week of directed physical education activity shall be provided."

An evaluation of the time requirement on the basis of *voluntary* participation in *elective* activities in the practice and play periods of the program, in addition to required instructional periods, revealed that 19, or 55 per cent, of the schools were meeting the time requirement of 300 minutes of directed activity for each boy per week. Of the remaining 16 schools, 2 were meeting the time requirement with the exception of a few boys; 3 were new centralizations and objective evaluation of time available was impossible when the study was made; and 11 needed activity periods, staff additions, or more indoor facilities in order to satisfactorily meet this requirement.

a) All schools provided the minimum of 2 school periods, totaling 90 minutes, of class instruction per week, while 21 schools provided more than this minimum.

b) Forty per cent of all boys in the schools studied participated in some form of interscholastic activity and were thus unquestionably meeting the time requirement.

c) Twenty-four schools provided special activity periods for laboratory programs.

d) All but 2 of the schools provided noon-hour activity periods.

e) Seven schools maintained Saturday activity periods.

f) Time made available for intramural activities was used by more than 75 per cent of all boys.

g) Approximately 100 per cent of all boys participated during noon-hour periods in fall and spring months, and more than 50 per cent of all boys participated daily during noon hour periods in winter months.

h) Twenty-five schools, or 71 per cent, used all facilities, both indoor and outdoor, when weather permitted.

i) All but 2 of the schools made allowance for informal recreational activities, thus making possible a greater daily participation.

9. *Athletic Activities.*—

"It shall be the duty of trustees and boards of education: To permit no athletic team to represent a school except in conformance with the regulations."

A study of athletic activities conducted in the schools studied revealed that no school permitted teams to represent it except in conformance with the regulations.

"To permit no post-season games or post-season tournaments, other than those conducted by school authorities in accordance with approved standards."

No post-season games or tournaments were participated in other than those conducted by school authorities in accordance with approved standards. Twenty-three of the 35 physical educators were opposed to post-season games with the exception of sectional tournaments as sponsored by the New York State Public High School Athletic Association.

10. *Finance.*—

"It shall be the duty of trustees and boards of education: To insure satisfactory financial support for its program."

All school boards made provision for financing interscholastic, intramural, and recreational programs.

a) All transportation was financed by the school boards through busses owned by the district, and 28 schools transported boys engaged in afterschool varsity team practices.

b) In addition to insurance maintained to cover all phases of the educational program, 19, or 55 per cent, of the schools made special provision for paying for the treatment of athletic injuries.

11. *Travel.*—

"It shall be the duty of trustees and boards of education: To approve all traveling of individuals or teams under their jurisdiction."

Travel of teams and individuals engaged in laboratory activities was in all cases approved and supervision was provided by the school.

a) No trips longer than the maximum of 100 miles set by the Statement of Policy Pursuant to the Regulations were taken.

b) Twenty-nine, or 83 per cent, of the physical educators interviewed approved the State regulation restricting the travel of athletic teams to a maximum of 100 miles for a single game.

12. *Division of Facilities.*—

"It shall be the duty of trustees and boards of education: To maintain an equitable division of facilities between boys and girls."

An equitable division of facilities for boys and girls activities was maintained in all but one of the schools. In no case did local pressure for winning teams necessitate curtailment of other phases of the laboratory program in preference to varsity athletics.

13. *Opponents of Equal Ability.*—

"It shall be the duty of trustees and boards of education: To equalize insofar as possible the powers of opponents in individual and group athletic competitions."

All schools belonged to leagues of approximately similar size, and analysis of league winners revealed that no school had monopolized championships in any league over a period of years.

14. *Medical Examinations.*—

"It shall be the duty of trustees and boards of education: To provide adequate health examinations before participation in strenuous activity and periodically throughout the season, and to permit no pupil to participate in such activity without the approval of the school medical officer."

All schools required medical examinations prior to participation in strenuous athletics, and pupils were not allowed to participate without approval of the school medical officer.

a) Fourteen, or 40 per cent, of the schools conducted periodic medical examinations for all varsity squad members during or before each sports season.

b) Twenty-one, or 60 per cent, of the schools did not require periodic medical examinations, and are therefore not conforming to the regulations, regardless of the fact that they did provide for individual examinations when necessary.

15. *Minimum Athletic Standards.*—

"It shall be the duty of trustees and boards of education to require interschool athletic activities for boys, grades 9 to 12 inclusive, to be conducted in accordance with the following minimum standards:

"A boy shall be eligible for only four years in any one interschool sport . . .

"A boy shall be eligible for interschool competition only between his fourteenth and nineteenth birthdays. He shall be eligible for interschool cross country, ice hockey, or football only between his fifteenth and nineteenth birthdays."

a) All the schools maintained the 4 year eligibility ruling, and 31 physical educators were entirely in accord with this regulation.

b) All the schools complied with the age limits set by the regulations. Eleven physical educators, however, felt that a boy who reached his nineteenth birthday during a school year should be allowed to finish the year as a sports' participant, and nine felt that boys who were physiologically suited should be allowed to participate in football practice before reaching fifteen years of age provided they were not allowed to play in interschool games.

16. *Scholastic Requirements.*—

"A boy is eligible for interschool competition only when he is a *bona fide* student, enrolled during the first 15 school days of the semester and has been in regular attendance 80 per cent of the school time."

Conformance to the *bona fide* student requirement was evident in all schools, and all physical educators expressed themselves as being in favor of this regulation. According to the Statement of Policy Pursuant to the Regulations it is not the intent of the regulations that this minimum standard be interpreted as necessitating the maintenance of satisfactory scholastic grades. Rather, the regulation intended to recognize the desirability of giving all boys an opportunity to participate in ath-

letic activities without emphasis on grades earned in academic subjects.

a) Scholastic eligibility rules for varsity sports' participants were maintained in 22 of the schools studied, which indicates that these schools are not conforming to the regulations. The Statement of Policy Pursuant to the Regulations, however, maintains that leagues are privileged to go beyond the minimum athletic standards set by the regulations. The schools which establish scholastic eligibility rules are governed by league organizations and may thus be considered to be acting within the regulations, although they are not acting in accordance with the full intent of the regulations.

17. *Transfer of Students.*—

"A boy who transfers from one school to another shall become eligible for interschool competition only after one semester of approved attendance unless the parents or guardians have changed residence to the new school district or the transfer is caused by a rearrangement of school district boundaries."

All schools acted in accordance with the regulation governing transfer of students, and all physical educators expressed themselves as being in favor of this regulation.

18. *Sports Participation.*—

"*Football.* Interschool competition in football shall be limited to a maximum of 7 games a season. At least 3 weeks of training shall precede the first game. No game shall be played with college freshmen. All organized team practice and games shall be limited to the period between September 1 and December 1. Interschool competition in football shall be permitted only in those schools which have 20 or more boys physically fit and eligible for participation. Competition shall be limited to boys enrolled in grades 9 through 12."

All participation in football was in accordance with the regulations and very few objections to the regulations governing this sport were voiced by physical educators.

"*Basketball.* Interschool competition in basketball shall be limited to a maximum of 16 scheduled games a season exclusive of sectional games. At least 2 weeks of organized practice shall precede the first game. All organized practice and games shall be limited to the period betwen Novmber 15 and April 1. Individual games of approved tournaments should be considered a part of the regular basketball season and shall count toward the total number of 16 games a season."

All participation in basketball was conducted in accordance with the regulations. Twelve physical educators, however, believed that adjustment should be made within various sections of the state as to length of season and number of games.

"*Ice Hockey.* Interschool competition in ice hockey shall be limited to a maximum of 12 games a season exclusive of sectional competition. All organized practice and games shall be limited to the period between November 15 and April 1."

"*Track and Field.* Interschool competition in outdoor track and field shall be limited to a maximum of five meets a season, exclusive of sectional competition. At least three weeks of training shall precede the first meet. All organized practice and meets shall be limited to the period between April 1 and the close of the school year. A boy shall be permitted in any one meet to compete only in:

One track event of a distance greater than 220 yards, or
One other track and one field event, or
Two other track events including relays."

Schools participating in ice hockey and track and field conducted these activities in accordance with the regulations.

CONCLUSION

Two pertinent conclusions may be made from study of the procedures followed in developing the state regulations, from recognition of the modern philosophy of physical education, and, from a study of the opinions of the physical educators in the schools studied. First, the regulations were developed on the basis of democratic procedures in that all interested groups had a voice in planning and approving the action taken and in that the changes were intended to benefit the majority of schools in the state. Second, review of the written opinions of recognized leaders in the field of physical education reveals that they are quite generally in sympathy with present regulations governing health and physical education in New York.

The regulations of the Commissioner of Education governing the laboratory phase of health and physical education have now been in effect more than two years. In spite of criticism, attacks from newspapers, and difficulties presented by limitations of personnel and facilities, these regulations have been quite generally applied in the 35 schools included in this study. Furthermore, the physical educators in 33 of the 35 schools expressed themselves as being in favor of the state regulations as thus constituted.

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ERRATA

In an article, "The Relation of Height and Weight Measurements to Intelligence and to Dominance-Submission Among a Group of College Freshmen," in the December, 1940, RESEARCH QUARTERLY (11: 4, 53–59), some inaccurate correlations were reported in Table III, p. 58. These errors were made in the office of the senior author and consist of an improper placing of decimal points.

The authors wish to make the following corrections of the data previously reported: The correlations between the physical and personality measurements for the women subjects are: height and dominance, .06; weight and dominance, –.02. The correlations for the total group of subjects are: height and dominance, .04 weight and dominance, .05. Obviously, part of the discussion in the last paragraph of the article must be reinterpreted in the light of the corrections here set forth. The authors, therefore, present the following reinterpretation, which should be substituted for part of the discussion found on page 58 of the original report:

"There is practically no relationship between height or weight measurements and dominance for either sex. The correlation between height and dominance for the total group is .04 (.04 for the men and .06 for the women). The correlation between weight and dominance for the group is .05 (.08 for the men and –.02 for the women)."

BOOK REVIEWS

DANCE: A CREATIVE ART EXPERIENCE. Margaret Newell H'Doubler. (New York: F. S. Crofts & Co., 1940) 200 pages, $2.50.

Rarely can an author state in his title a thesis so sincerely believed and steadfastly maintained throughout a book as has Margaret N. H'Doubler in her most recent publication. Indeed, rarely is it given to any individual to "live" a thesis so completely as has Miss H'Doubler in her career as a dance educator. That dance is fundamentally a creative art experience has been the premise on which this remarkable woman has built a lifetime of work and, in so doing, exerted a tremendous influence over the field of education in general and physical education in particular. The gracious tribute paid her by Gertrude E. Johnson, fellow professor at the University of Wisconsin, in the foreword tells of her successful endeavor in behalf of academic acceptance of dance and adds: "That her tireless energy, keen intellect, and wide study have made advanced academic degrees attainable for students in dance is, in the last analysis, not to be compared in importance to the possibilities released through creative growth of mind and body." It is in behalf of those potentialities—awaiting release through creative activity—and the individuals who grow through such release that Miss H'Doubler writes. That her work has been carried on in the department of physical education rather than fine arts has been due, she says, to the foresight and generosity of that department.

Dance: A Creative Art Experience is of general interest to any student of esthetics and art and of special interest to those dance participants—teachers and pupils alike—who have the courage to ask "Where are we going and why?" and the strength and patience to attempt a valid answer. Miss H'Doubler's answer is held until her final chapter, "Why Dance?" and is exceedingly thoughtful and provocative of thought on the part of the reader. Believing that in no age can man live by intellect alone, she avers that "of all art forms, dance is the most generally available, since everyone finds the instrument needed for his purpose in his own body." Further developing this theme, she presents the important matter of discipline in art and life in the statement that "in the effort to attain unity in expression, the emotional nature is brought under control and given the strength of restraint."

Quotations are almost unavoidable since the author believes firmly what she is saying and manages, with enviable success, to say what she means. Although some of the book is slow reading, the reason is rather that it stimulates thoughtful study and reaction than that it is obscurely worded. A tendency toward technical terminology is to be expected of one so vitally concerned in all the facets of her profession.

Certain chapters in the book must be singled out for special mention. Among those are the discussions of "Form As Organic Unity" and "Form and Content." In the latter, a distinction is made between "manifestative" and "representative" dance, which should do much to subdue the effort to label dance styles as such for want of a real feeling of discrimination. In manifestative dances, concerned with

"values sensed" rather than "knowledge about," she includes *dances of action* and *dances of mood and emotion*. Representative dances are *thematic* or *dances of characterization*. In Miss H'Doubler's helpful analysis of form as organic unity she traces the evolution of dance (a similar analogy could be made with any art) through three levels of aesthetic maturity.

For some reason, perhaps to avoid making dance seem "personal" in any way, the author has avoided mention of any specific names in dance. Her concise sketch of dance history contains no figures—only the landscape in which they lived. Wayne Claxton's illustrations are not "named" either, although it would be difficult to miss some of the characteristics of style so well delineated in his vigorous sketches.

A tribute in closing should be paid to F. S. Crofts, publishers, for the exceptionally attractive format of the book. Its beautifully conceived cover, easy type, and striking page makeup contribute toward making *Dance: A Creative Art Experience* a book to read and own.

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ELEMENTS OF HUMAN PHYSIOLOGY. Miriam Scott Lucas, Ph.D. (Philadelphia: Lea and Febiger, 1940) 400 pages, $4.50.

This book covers a tremendous amount of subject matter. It is divided into four parts: Movement and Support: Integration in the Body; Metabolism and Water Balance; and Reproduction and Endocrine Function. Each section is preceded by a concise introduction or orientation which is invaluable to the beginner or intermediary student of physiology.

The author shows an amazing capacity for brevity consistent with completeness. Throughout the book there is clarity and order of presentation. The author's adequate descriptions of the structures under consideration are accompanied with numerous plates and diagrams, all of which are intended to give the student a clear mental image which is so necessary for comprehension. In addition to the descriptions, plates, and diagrams, Dr. Lucas has compiled tables which bring together all the salient points concerning a comparison of the types of muscle; the various reflexes; activities of organs of digestion and digestive enzymes; nutrition; and endocrine function.

The material presented is all up to date, especially the sections devoted to metabolism, nutrition, reproduction, and endocrines.

Dr. Lucas has included sufficient controversial matter to stimulate an interest in physiology, without confusing any major issues. There have been no conspicuous omissions or over-condensations. The book does not contain an extensive bibliography; wherever further information is desirable, references are given to the original source.

Intermediary students of physiology, pharmacists, nurses, and physical education students, as well as instructors in physiology will find this book quite satisfactory.

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HEALTHFUL LIVING. Harold S. Diehl, M.D. (New York: Whittlesey House, 1941) 500 pages, $2.75.

Dr. Diehl, in his opening chapter, asks this challenging question: "Is it sensible for intelligent persons to remain in ignorance concerning matters of such vital importance" as health?

We hear much of what science has done and is doing to lengthen life. Some people misunderstand the results obtained and believe they are merely making old people live to be older. On the contrary the chances of long life for a person of fifty years of age are possibly slightly less than they were a generation ago. The added years are not being added after the half century mark is passed, but before it has been reached. It is the lives saved during infancy and up to the age of ten that makes all the additional years of which we hear so much. The death rate among children under ten years old

dropped 64 per cent during the decade ending with 1930.

Studies made by two eminent statisticians quoted here show that to be born in South Dakota gives a person a life expectancy at birth that "is very close to the highest found anywhere in the world."

Tables and charts are given by which any reader may see what his or her chances for old age are apt to be. Also given are the causes of death. Here we find cancer stealing up to second place from tenth place in seven short years; tuberculosis dropping from first to seventh in that length of time, with heart diseases now leading all the others, and pneumonia death rate more than cut in half.

But mere life is not enough to strive for. To be enjoyed to the full it must be healthy life. What are the most common forms of illness? The most "common" of all are "common colds" and bronchitis. Respiratory diseases lead all the rest at all ages. At all ages, too, accidents are a major health hazard. Some fascinating, terrifying, and enlightening facts are given about accidents at home, in industry, and on the nation's highways.

Of heart disease—the leading cause of death—the author says that "rheumatic fever contracted in childhood is responsible for 25 per cent" of these deaths occurring before the victims have reached the age of fifty. What causes it, where it is most frequently found and how it is affected by race, climate, and environment Dr. Diehl discusses. Other causes of death are also interestingly dealt with.

So, too, is the subject of diet. Speaking of vitamins, he says, "There is no evidence that growth can be promoted or health improved by adding to the diet more vitamins than it is possible to obtain from the *proper selection* of natural foods." In order that the reader may make such selection, clear and concise information is given concerning the right foods and the role that the vitamins they contain play in the maintenance of health.

The chapter entitled "The Choice of Foods" succintly answers the most frequently-asked questions giving an almost incredibly large amount of information within the small space of a very few pages. But this chapter, like each of the others throughout the book, is followed by a list of references and reading suggestions for those who would more thoroughly study the subject. For the average lay reader, for whom the book was written, the information will doubtless prove sufficient.

Almost twice as many pages are devoted to weight and its control. Here, of course, food is further discussed with reducing diets given, and a table of equivalents for bread. How many dates take the place of two slices of bread? Does one egg equal one slice of bread in caloric value? And what about a veal chop?

Speaking of digestive upsets, Dr. Diehl says that fortunately they are not quite so common as the sponsors of "grand opera stars and crooning cowboys" on the radio would have us all believe. Nevertheless about one-third of all cancer deaths are due to cancer of the stomach and duodenal ulcers can and do give many people trouble. Such conditions cannot possibly be cured by patent medicines but "demand careful diagnosis and medical or surgical treatment."

Dr. Diehl declares that of the cathartics for which fifty million dollars are spent a year, many do more harm than good. Self-diagnosed constipation may not be what it seems. This trouble from which "approximately 75 per cent of American people" suffer is thoroughly and helpfully discussed here.

How may food infections be avoided? Can a person really have ptomaine poisoning? How should milk be cared for in the home; and is raw milk "safe?" Is tobacco a curse or a blessing, so far as health is concerned? Should growing children smoke? Drink alcohol?

Dr. Harold S. Diehl has devoted a great deal of his life to health education of young folks. He is Director of Health Studies for the American Youth Commission; a member of the Health Council of the Boys' Clubs of America; and the former president of the American Student Health Association. Let

him tell you, as he does so vividly in *Healthful Living*, of the relationship between alcohol and the venereal diseases! Let him also tell you, as he does in his closing chapter, how to choose a health adviser.

But before his closing chapter this author who has conscientiously endeavored not to omit or slight any phase of healthful living, tells how to keep well through exercise and rest; what sunlight and fresh air have to offer, and of what use are commercial substitutes for sunshine.

Fearlessly, freely, Dr. Diehl pricks the bubbles of advertisers who claim curative powers for pills filled with protection against colds; drugs that overcome colds once contracted; gargles, nose drops, and sprays. Concerning dietary prevention he says that though the theories may sound appealing, scientific evidence has not established them as facts.

Eyes and teeth and the various glands of the body are included among the subjects talked about, as is also sex life. Dr. Diehl says that many "pathetic and tragic examples of ignorance and misinformation on this subject" (sex) are being encountered again and again. Because this is true Dr. Diehl has devoted a great deal of time and thought to a careful consideration of marriage, parenthood, and infant care.

In reading this volume through—and it is a book one really enjoys reading through—it becomes very clear that the author has rendered an invaluable service to both the young and older person. On each page—almost in every sentence—one fact stands out: here is a doctor who was not satisfied merely to write a book on healthful living. He has weighed each word for its educational value and has honestly endeavored to include every possible phase of personal health. He has written as if he were sitting down with a group of thoughtful people—not physicians, but men and women in the average walks of life; men and women who want to keep well.

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MOTOR PERFORMANCE IN ADOLESCENCE. Anna Espenschade. (Washington, D.C.: Society for Research in Child Development, National Research Council, 1940) 136 pages.

Under the direction of the Society for Research in Child Development, this study of motor performance in adolescence, which includes the study on Relationships with Measures of Physical Growth and Maturity, appears as a monograph, Volume V, Serial 24, Number I.

Assistance of the Works Progress Administration and the National Youth Administration is given recognition by the author. The study is divided into two parts. Part I is a presentation of the data and is subdivided into (1) the presentation which contains a review of the literature of interrelationships of motor abilities, measurement of gross motor performance, relationship of motor ability to age, sex, physical growth and maturity; (2) the selection and administration of tests; (3) the analysis of the data and (4) the summary of the problem.

Part II is devoted to further analysis of interrelationships.

Before concluding with eighty selected references and an appendix of motor tests, the author has summarized the study and has indicated certain motor actions for adolescent children which may be drawn from the findings.

It has been shown that performances of boys and girls at any one time show wide variations within the group and in boys change rapidly from time to time, with growth. Thus an unselected group may participate without inequality only in activities which are carried on independently of others, as in gymnastics and stunts, or in relatively non-specialized types of group activity, for example in folk or social dancing or certain group games of low organization. In highly organized team sports or in individual activities requiring special skills, however, classification of groups on a skill basis is essential if participants are to obtain full satisfac-

tion of physiological and ego-integrative needs.

Sex differences in motor performance are so great in adolescence that joint participation in physical activities will, except in rare cases, meet only a social need. Thus the type of activity selected for mixed groups should be such that maximum opportunity is afforded for social experience.

The fact that motor performances show varying degrees of relationship with each other indicates that an individual does not have equal ability in all types of activity. The program in physical education should allow for such intraindividual differences. At the same time it must be so planned as to permit and encourage the discovery and development of special abilities and interests.

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THE SPORTSMAN'S LIBRARY. Ernest R. Gee. (New York: R. R. Bowker Co., 1940) 158 pages, limited edition, $6.00.

Every physical educator and recreation leader who has the urge to collect literature in the various fields of sports and recreation will find that in *The Sportsman's Library* Mr. Gee has performed a real service. Here, in one concise, well-prepared and delightfully printed book are to be found nearly one thousand of the more important books that interest the collecting sportsman. This is as to be expected, for Mr. Gee is peculiarly well fitted for his task. He has devoted a lifetime to his specialty, as a dealer and as a collector, and is today the Emily Post of sports literature. He has a touch and a feel for books that is deep rooted. He has personally handled the great majority of the gems he includes in his book. He has selected well and with authority.

The Sportsman's Library, limited to an edition of six hundred copies, is devoted largely to books on the field sports by American and English writers. The dates range from the excessively rare and valuable *Book of St. Albans* of 1486 down to those of 1940 imprint. An idea of the scope of Mr. Gee's work can be best gained from its contents: fox-hunting (162 titles); racing and steeplechasing (50 titles); horse breeding, stud books, and racing calendars (63 titles); horse riding, and horsemanship (69 titles); polo (27 titles); big game (44 titles); dogs and shooting (105 titles); angling (156 titles); poetry of sport (54 titles); yachting (45 titles); coaching (26 titles); sporting fiction (71 titles); miscellaneous (98 titles). The more important sporting magazines are included under miscellaneous, as are nine archery entries, seven on cockfighting, ten on falconry, six on tennis, four on fencing, and some others.

The arrangement within each subject is alphabetically by author, or by title where the author is not known. Entries include date and place of publication but do not give publisher or price. We believe the omission of publisher's name is unfortunate, albeit common in books of this type. As for price, since the condition, rarity and even previous ownership of a particular copy have such an important bearing on the value of any individual title, it is not such a serious omission. We do believe, however, that it would have been helpful to include publication price of some of the more recent items.

The books listed are first editions. There are notes regarding later editions and reprints and, in some cases, notes indicating the rarity and importance of the book. We examined the index to authors and titles and found it to be accurate.

There is an important and excellently written introductory article tracing the history and development of sporting literature. The student and collector of sporting literature owes it to himself to read this, if no other article on the subject.

We do not wish to quibble with Mr. Gee over the inclusion or exclusion of certain titles when he has made such a patently sound selection, yet we must

admit we were surprised not to find Ascham's *Toxophilus*, Suffolk and Berkshire's *Encyclopaedia of Sport*, and one or two others, included.

We can do no less than recommend this book to those physical educators, recreation leaders, and other sportsmen who plan to collect books themselves or who are frequently called upon to advise others who are making such collections. It is a book they should definitely know about if not own.

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THE MARCH OF MEDICINE, Number IV of the New York Academy of Medicine Lectures to the Laity. (New York, Columbia University Press, 1940) 168 pages, $2.00.

This book is a collection of six lectures: "From Folkways to Modern Medicine" by Walter C. Alvarez, M.D., Mayo Clinic, Rochester, Minn.; "Health in Elizabethan England" by Sanford V. Larkey, M.D., Librarian of the Welch Medical Library, Lecturer in the History of Medicine, Johns Hopkins University; "Not So Long Ago" by Cecil K. Drinker, M.D., Sc.D., Professor of Physiology and Dean of the School of Public Health, Harvard University; "The Romance of Modern Surgery" by Charles Gordon Heyd, M.D., F.A.C.S., D.Sc., New York; "The Story of Insanity" by R. G. Hoskins, M.D., Ph.D., Director of Research, The Memorial Foundation for Endocrine Research, Harvard Medical School and The Worcester State Hospital, Worcester, Mass.; "The Cinderella of Medicine" by Karl A. Menninger, M.D., The Menninger Clinic, Topeka, Kansas.

The reader will find this collection a delightful group of essays by leaders in their respective fields who can and do speak with authority. Dr. Alvarez's essay traces certain beliefs and superstitions through folkways into modern medicine; he explains why the quack or cultist sometimes succeeds (in certain cases) where the scientifically trained physician fails. He ends with a plea that the research worker be supported and encouraged by the layman. Such support and encouragement should take the form of not supporting antivivisection legislation or agitation; a reasonable plea. Dr. Larkey's essay on health in Elizabethan England gives an excellent picture of beliefs and practices of that time. The humoral theory of disease which played so prominent a part in literature and medicine is described.

Dr. Drinker's essay on life and customs in Colonial America was gleaned from an old diary of one of his ancestors. It gives a clear idea of how much improvement in public and community sanitation has occurred in 150 years. Dr. Heyd's paper traces the development of modern surgery in an interesting and instructive manner. Dr. Hoskins' essay on the story of insanity contains much information on the development of psychiatry but only one paragraph on its most recent accomplishments. The student of health education would undoubtedly appreciate a more detailed account of this latest chapter of the story. The book ends with a discussion of psychiatry in relation to other branches of medicine by Dr. Menninger, who presents a strong case for a specialty of ever increasing importance. This importance may be appreciated when one realizes that more than half of all illness is mental or emotional in character.

Such a book as this might well be used for collateral reading in college courses in hygiene. There is a dearth of well written material suitable for the ordinary student, who can understand plain English but who has difficulty with the vocabulary found in most works on the history of medicine. The authors have done a good job of discussing rather complex subject matter in simple terms.

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ESSENTIALS OF NUTRITION. Dr. Henry C. Sherman and Caroline Sherman Lanford. (New York: The Macmillan Company, 1940) 418 pages, $3.50.

This up-to-the-minute book on nutrition has been written for use by those who may not have any background of science, though of course such a background will make it even more interesting.

The opening sentence of the first chapter states the fact that today boys and girls enter college "taller and yet younger" than were first-year students thirty years ago.

Why is this so? Because of applied scientific knowledge concerning living conditions, particularly knowledge gained in the nutrition field. Acceptance of the fact that health is not merely freedom from disease but a positive quality of living has brought about dietary changes which in turn have resulted in increased physical growth.

This is noticeable to a very marked degree among the children of immigrants. Whereas once heredity was accepted as the deciding factor in physique, it now is known that on a well-planned American diet carefully followed through the first few years of growth the children and grandchildren of the foreign born approach the typical American body build in a surprisingly short time. The authors call this influence on growth "internal environment," a term explained in the glossary as meaning the condition existing within the body as a result of factors which are not hereditary—a condition largely influenced by nutrition.

What happens to the nutrients supplied by food eaten? What are these and what role does each one play? Through easy-to-follow explanations accompanied by photographs and drawings the student follows different foods as they enter the mouth and submit themselves to the process of digestion, or "The Fate of Foodstuffs."

The once-accepted comparison of the body with a heat or steam engine is emphatically discarded here since "there are no foods that burn up body fat." It may be compared though with an automobile—the vitamins being the ignition sparks.

Basal metabolism—to some still a mystery—is simply described by word and picture. Then energy metabolism is discussed. How much energy or calories per hour will a student use up while typing out a thesis? Dancing a waltz? Dancing a fox trot? Rowing in a race? Does it call for more energy or less to read aloud while sitting down or to stand up, utterly relaxed? Are more calories burned by a coed while pressing a dress than when she is washing dinner dishes? Which is more strenuous: runing 5.3 miles per hour or swimming in the pool?

To try to increase metabolism by an artificial means, in order to burn up fat and reduce weight, is a dangerous procedure. Even exercise, Dr. Sherman points out, cannot be relied upon as a dependable means of reducing. Dr. Mary Swartz Rose is quoted as sensibly saying that "the only form of exercise essential to the control of body weight is the exercise of the intelligence."

How safely to reduce is told here in a way which makes it sound really easy, but the question is raised as to whether or not during youth loss of weight is desirable from the viewpoint of health. Underweight is often dangerous. Instructions are given for overcoming it.

The "protein problem" is of outstanding interest since proteins are needed for the construction of the tissues of the body — tissues constantly needing repair or replacement or both—the protein provision must be adequate to meet the daily needs. Nor is it used alone for building tissue. Some of it is called upon to carry oxygen to the tissues from the lungs. In this role it is called hemoglobin. Other proteins perform functions which are also of vital importance.

But are all proteins of equal value? That they are not has been proved definitely through animal experimentation which is described and illustrated through charts. Some are "complete," some "partially complete," some "in-

complete." Upon their completeness depends, largely, their value in nutrition. (Dr. Sherman relieves the mind of the reader at this point by telling what the best sources of protein are.)

Minerals are most essential in the diet, but which ones are needed? In what quantities? Where are they found? Eleven are now accepted as important. Most of us have become used to accepting a need for calcium, phosphorus, and iodine, for instance, and of course the value of iron has long been appreciated. But can you name all of the others too? Do you know how each one functions?

So much is said, in advertising matter, about alkaline reserve and foods which are acid-forming, that the authentic information on this subject given here is surely welcome. It also helps the reader understand why some fruits are easily digested while others may cause more or less disturbance. Knowing how important is the daily intake of both calcium and phosphorus in the diet, one welcomes the details which are given here concerning where these may abundantly be found. The same is true of iodine and iron—the other two minerals each having a chapter devoted to it.

When Henry the Eighth wanted a salad his lackeyes had to purchase the "makings" abroad. Small wonder that scurvy was so prevalent then! For those were the days before Vitamin C was discovered. At one time in the Japanese Navy from 20 to 40 per cent of the men were regularly on the sick list suffering from beriberi. That was before Dr. Takaki set about to find Vitamin B —now popularly called thiamin.

Poverty and pellagra stalked hand in hand for years before the complex "B-Vitamins" were found to contain preventive agents. (The original Vitamin B has now been separated into riboflavin, of which much is now being heard, and at least four or five other vital factors.) Pellagra now is being battled with nicotinic acid most effectively.

All these facts are elaborated upon by Dr. Sherman who gives the very latest published facts about vitamins many have not even heard of and about research work on a factor which may turn gray hair black.

Of course the stories of Vitamins A and D are also told with latest news resulting from the constant research work being carried on.

Food's effect upon teeth; an analysis of the chief types of foods and what foods cost; and tables giving the energy values of foods complete the book.

In the closing chapter the value of a "nutrition policy" is emphasized. More money to be spent in research, education; more work done for the protection of public health.

This book will be especially welcome to the student of nutrition or dietetics. For each chapter is followed by exercises and suggested readings which are stimulating.

In addition to the glossary already mentioned, there are tables, statistical data, and an index.

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